

A WORD BOOK

HAWKINS'
MECHANICAL
DICTIONARY

A WORK BOOK



GEORGE F. WATCOCK

"FOR ONE WORD A MAN IS OFTEN DEEMED TO BE WISE, AND
FOR ONE WORD HE IS OFTEN DEEMED TO BE FOOLISH. WE OUGHT
TO BE CAREFUL, INDEED, WHAT WE SAY."

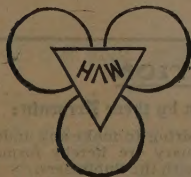
HAWKINS' MECHANICAL DICTIONARY

A

CYCLOPEDIA OF WORDS, TERMS,
PHRASES AND DATA USED IN
THE MECHANIC ARTS, TRADES
AND SCIENCES

BY

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AND ASSOCIATES



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Impression, 1928

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AUTHOR'S PREFACE.

“Remark,” says Sir Walter Besant, “that the first thing you want in a language is the vocabulary or mother tongue; men who learn many languages begin after the manner of Adam, with the names, not after the manner of the schoolmaster, with the grammar,” hence this is a book, first of names, second of explanations.

A dictionary is an inventory of a language; much more, indeed, but this primarily, its business is to collect and arrange the words, which, with certain exceptions, those writing in the language have used, and those who have heard them spoken, have understood their meaning.

When other matter is added besides the words, this is called encyclopedic, in its widest sense defined as “a work arranged like a dictionary giving a comprehensive summary of all branches of learning”—in this case of all mechanics.

An example of the added or cyclopedic matter is found in the brief biographical sketches of nearly one hundred men who have been the foremost pioneers in achievement in the world of science and mechanics.

In the same line, many tables, formulas, receipts and practical suggestions have been added to give interest to its pages. Special effort has also been directed toward rendering the information given, of such practical utility that the work may serve as a trustworthy guide; to this end some simplified rules have been introduced, with plain examples of their application.

In short, the contents of the book will, it is thought, justify its name as a *hand word book*.

An extended “definition” of Applied Grammar will be found in the back part of the book, under the section marked Additional Aids.

This is printed from the author’s personal notes to help students of the dictionary to the higher field of English composition.

There is gold in this part of the book to some who will apply their energies to the task of extracting its treasures.

In considering the book as a whole it will be noticed that the main words are printed in heavy italics. A little closer examination will show that in defining these, plain mechanical terms and phrases have been used. This gives a oneness to the volume which is charming.

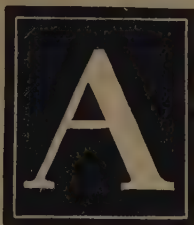
The maker of a dictionary for general use—that is, a hand word book, is not called upon to give anything more than a brief history and epitome of his language; its total results are his justification for putting it forth.

For more than kind cooperation in the arduous task incident to the completion of this work the author desires to name specially MR. FRANK DUNCAN GRAHAM, B.S., M.S. (Princeton University, 1899) and M.E. (Stevens Institute, 1902). Mr. Graham, in his practical experience, has received both stationary and marine engineer's licenses. Second, the author's thanks are extended to MR. JOHN HARMS, M.E. (Leyden University), who since graduation has had a world wide experience, beginning with De Lesseps' Panama Canal; pending his work on this book, he received an appointment as chief engineer in laying out the hydro-electric power plant of Rio Janeiro—an immense undertaking. From this task he returned broken somewhat in health to resume his work on the dictionary, bringing to its completion a life long experience in engineering.

Credit is also due to MR. VICTOR HAWKINS for untiring industry in the important word selection and in the general make-up of the volume. Following in order, but equal in importance, the author names MESSRS. CHAS. E. BOOTH, EDW. F. STEVENS, assistant librarian at Pratt Institute, and R. SPRING for untiring and skillful work in the preparation and revision of author's manuscript, also MR. HARRY HARRISON and MR. S. B. ASCHER of the L. MIDDLEDITCH PRESS.

N. HAWKINS.

New York City



A.—1. The first letter of the English and many other alphabets.

2. The shortened form of An, an adjective, commonly called the indefinite article and signifying one or any.

A1.—An abbreviation signifying a wooden ship built to the highest classification of Lloyds' Register.

2. A term used colloquially to express superiority.

A. B.—In navigation, an abbreviation for *able bodied seaman*. After an indefinite time as boy, a young seaman is rated as *ordinary seaman* (O. S.), in which capacity he has to serve two years before he ranks as A. B. From this, if his conduct and qualifications are good, he becomes a petty officer as Quarter Master, etc., or to higher ranks as Boatswain or Gunner. Should a young seaman desire to qualify as an officer, four year's service (in sailing ships) as A. B. (or six in steamers), will be held as equal to an apprenticeship, and entitle him to sit for an examination for a second mate's certificate.

Abacus.—1. In mechanics, a calculating device consisting of a frame with wires upon which small balls are run back and forward; used for *score-tallying*.

2. A Chinese calculating instrument in which balls, slid upon wires, or counters, moved within grooves, represent figures or arithmetical quantities.

Abaft.—Towards the stern of a ship; back; behind; as, *abaft* the mainmast.

Abaka.—A fiber from which manilla rope is made. Ropes and cables of this material float in sea water.

Abate.—To bring down or reduce from a higher to a lower state, number or degree; to lessen; to diminish; to contract; to moderate; to cut short; as, to *abate* a demand.

Abattoir.—A public slaughter house, under the control of the proper sanitary authorities. This provides for the proper regulation and inspection of meat supply; the drainage, water supply and ventilation being kept in order, and all refuse immediately removed.

Abb.—In weaving, yarn prepared for the *warp*.

Abbreviation.—A short or contracted form of a word or title, as H. P. for *horsepower*. In mathematics and other

sciences, abbreviated *signs* and *symbols* are constantly in use.

Abeam.—Opposite the center of a ship's side; as the wind is *abeam*.

Ability.—The quality or state of being able; power to perform, whether physical, intellectual, conventional, or legal; capacity; skill in doing.

Able.—Having sufficient power, strength, force, skill, means, or resources of any kind to accomplish the object; possessed of qualifications rendering competent for some end: competent; qualified.

Aboard.—On board; into or within a ship or boat; hence, into or within a *railway car*.

About.—In the immediate neighborhood of; in proximity to; near, as to place; by or on one's person.

About Sledge.—In blacksmithing, swinging the sledge hammer over the shoulder with a circular sweep, so as to strike a heavy blow.

Above.—In or to a higher place; higher than; on or over the upper surface; over; opposed to below or *beneath*.

Abradant.—A material, generally in powder, for grinding. The term includes *emery*, *sand*, *glass*, and many other materials.

Abrasive.—In mechanics, an agent employed in grinding or wearing away by friction or attrition. The more common materials for this purpose are *emery*, powdered glass and sand.

Abrasive Processes.—Abrasive cutting is performed by means of stones, sand, *emery*, glass, corundum, carborundum, crocus, chilled globules of iron, and in some cases by soft, friable iron alone.

Abreast.—1. Side by side, with breasts in a line; as, two men could hardly walk abreast.

2. In navigation, side by side; also, opposite; over against; on a line with a vessel's beam.

Abridgement.—The act of abridging, or the state of being abridged; lessening; reduction, or deprivation; as, an *abridgement* of expenses.

Abrupt.—Without notice to prepare the mind for the event; sudden; hasty; unceremonious.

Absolute Pressure.—That measured from the true zero or point of no pressure. It is equal to the pressure indicated upon the gauge, plus that of the atmosphere, which is usually taken as 14.7 or 15 lbs. Thus 68 lbs. gauge pressure is 82.7 or 83 lbs. *absolute*.

Absolute Strength.—In mechanics, the actual breaking strength of a bar or structure, as distinguished from the safe or working load.

Absolute Temperature.—In physics, the actual temperature of anything, reckoned from *absolute zero*. It is taken as the temperature indicated by the thermometer or similar instrument, to which is added 273° centigrade or 460° Fahrenheit, the difference between absolute zero and the zeros of the respective thermometric scales, which are arbitrarily fixed.

Absolute Zero.—In physics, temperature or the heat which it represents is regarded as a manifestation of molecular activity in any substance, the higher the temperature, the greater the motion or vibration among the molecules of which every solid, liquid or gaseous body is composed. Experiments have demonstrated that a gas expands when at the freezing point and under constant pressure about $\frac{1}{273}$ of its volume for each increase of 1° Fahr. in pressure. This tends to show, that at some point about 492°—32° or 460° below zero of Fahrenheit's scale, the volume of the gas would have become zero or it would have lost all the molecular vibration which manifests itself as heat. The temperature of this *absolute zero point*, from which all temperatures of gases are reckoned, is estimated at—273.1° C., or—459.4° F. The lowest temperatures yet obtained by anyone are those at which hydrogen liquefies—423° F., and its freezing point, 430.6° F. is not 30° from absolute zero.

Absorb.—To drink in, or suck up, as a sponge *absorbs* water.

Absorber.—In refrigeration, the vessel wherein the ammonia gas from the ex-

pansion coils in the refrigerator is again mixed with the water or *poor liquor* from which it had been distilled, and which has been cooled for the purpose.

Absorbing Power.—In building, the capacity of timber for absorbing the preservative fluid used in its impregnation. The absorbing power varies with the nature of the wood subjected thereto.

Absorbing Well.—In hydraulics, a well or shaft, dug, bored, or driven through a retentive stratum, to allow surface or spring water to pass to a *porous stratum*, below the former, so as to form an outlet or drainage.

Absorption of Gases.—In physics, the property which all liquids possess in greater or less degree of taking a certain quantity of gas into chemical combination with themselves. Heat is given off during this process of absorption, and, should it afterwards be desired to separate the gases, an equivalent amount of heat to that given off, must be applied to the liquid. This principle is the foundation of the *ammonia absorption process* of refrigeration as water at 32° F. can absorb over one thousand times its volume of ammonia gas.

Absorption Process.—A system of refrigeration, depending upon the remarkable affinity of ammonia for water. Aqua ammonia is subjected to the heat of a steam-coil in a boiler or generator, the ammonia gas immediately dissociating from the water, and, after passing through vessels termed the analyzer and rectifier, designed to separate all watery particles, it is liquefied, still under pressure, in a surface condenser. From the liquifier it escapes through a regulating valve into the coils or manifolds of the refrigerator wherein is little pressure, and there again expands into a gas, taking the heat necessary for this change from the contents of the refrigerator, be it air, water or brine, thus chilling or freezing them. After performing its work in the refrigerator or ice tank, the ammonia gas is led into the *absorber*, where it is mingled again with the *poor liquor* from which it was originally evaporated, and finally pumped back into the *generator* to be used over again.

Abstract.—1. To withdraw; to separate; to take away.

2. In chemistry, to separate, as the more volatile or soluble parts of a substance, by distillation or other chemical processes.

Abundance.—An overflowing fullness; ample sufficiency; great plenty; profusion; copious supply; superfluity; wealth; strictly applicable to quantity only, but sometimes used of number.

Abut.—To project; to terminate or border; to be contiguous; to meet.

Abut End.—That on, or against which a body abuts or presses. *But end* is a shorter term for this word.

Abutment.—A mass of masonry work supporting the end of an arch or bridge; also the natural rock from which the bridge may spring.

Abutment Piece.—A block or plank transmitting the thrust of a shore or strut to a wall, etc., and distributing it over a large area. Equivalent to the *waling planks* used in timbering excavations.

Abutting Joint.—In carpentry, a joint in which the fibers of one piece are perpendicular to those of the other.

Acanthus.—In architecture, an ornament resembling the foliage or leaves of the *acanthus*, used as brackets on pillars in the Corinthian order of architecture.

Acceleration.—In mechanics and physics, the rate of increase of velocity or the average increase of velocity in a unit of time.

Accent.—1. A superior force of voice upon some *particular syllable* of a word or a phrase, distinguishing it from the others.

2. In mathematics, a mark placed at the right hand of a letter, and a little above it, to distinguish magnitudes of a similar kind expressed by the same letter, but differing in value.

Accept.—To receive with a consenting mind; to take; to agree.

Accessories.—Something that goes along with; a small machine that accompanies and aids another one, as a governor is an accessory of the steam engine.

Accident.—An event that takes place without one's foresight or expectation; an event which proceeds from an unknown cause, and therefore not expected; chance; casualty.

Acidimeter.—An instrument for determining the purity or strength of acids, founded on the principle that the strength of any sample of acid is proportionate to the quantity of carbonic acid gas which it disengages from a carbonate of soda or potash.

Acclivity.—A slope or inclination of the earth, as the side of a hill, considered as ascending, in opposition to *declivity* or descending; an upward slope; ascent.

Accommodation Bridge.—A gangway provided with a railing, alongside the tracks of a railroad bridge or trestle. Although not a highway bridge, it is made for the public use.

Accommodation Ladder.—In navigation, a portable stairway guarded by hand ropes; used to give access to a ship for officers and passengers, generally from boats.

Accommodation Train.—On a railway, a local service passenger train stopping for traffic at all stations.

Accomplish.—1. To complete; as, time or distance.

2. To bring to an issue of full success; to effect; to perform; to execute fully; to fulfill; as, to *accomplish* a design or an object.

Account Current.—In office accounting, a running or continued account between two or more parties, or a statement of the particulars of such an account.

Accouplement.—In carpentry, a timber tie or brace.

Accumulate.—To heap up in a mass; to pile up; to collect or bring together; to amass.

Accumulator.—In hydraulic machinery, a cylinder in which water is stored, under pressure, to serve as a reservoir and regulator of power, so that an intermittent and fluctuating demand may be met by pumps running under a uniform load. The ram of the accumulator, which has a very long stroke, is weighted to balance the desired working pressure per square inch; either by weights of cast iron, boxes filled with concrete, or (on shipboard) a larger piston under a lower pressure. The pumps deliver water against the load on the accumulator plunger which rises until the cylinder is full, when suitable gearing checks or closes the steam valve of the pump. As the demands of the various machines come on it, the accumulator cylinder begins to discharge, the ram falls and the pumps start again. If the demand is constant the pump runs all the time, and by reason of the accumulator, a pump delivering ten horse-power regularly can take care of a machine requiring fifty horse-power one minute out of every five, the accumulator falling as the load is applied and rising again as the pump gains on it.

Accuracy.—The state of being accurate, freedom from mistakes; this exemption arising from carefulness; exact conformity to truth, or to rule or model; precision; exactness; nicety; correctness; as the value of testimony depends on its *accuracy*.

Acetate.—A salt formed by the action of acetic acid upon a base; as *acetate of lead*. Much used in the arts as *sugar of lead*.

Acetate of Copper.—A substance commonly known as *verdigris*. It is prepared by exposing copper plates to the vapor of acetic acid and the action of the air; it is much used in dyeing, calico-printing, gilding, electroplating, etc.

Acetic Acid.—An organic acid, usually met with as a thirty-three per cent. solution in water, is a clear colorless liquid with a penetrating, pleasant odor and taste. The pure acid solidifies at temperatures below 60° F. and hence is called *glacial acetic acid*. *Vinegars* are solutions of five to fifteen per cent. acetic acid, accompanied by various matters characteristic of the source whence they were obtained. The acid is prepared by the oxidation of alcohol, the glacial by the destructive distillation of wood.

Acetone.—A liquid with a characteristic smell, obtained as a by-product in the distillation of wood alcohol. Acetone is used in the manufacture of chloroform, iodoform, etc. It dissolves many times its own volume of *acetylene gas*, the quantity depending upon the pressure, and is therefore used in connection with reservoirs for storing acetylene for *automobile lights*.

Acetylated Alcohol.—Alcohol which has been denatured, or rendered useless and dangerous as a beverage by the addition of acetylene, which also increases its fuel value.

Acetylene.—A gaseous hydrocarbon, of interest as being the only hydrocarbon which can be prepared by direct union of its elements. It is used considerably as an illuminant, as it burns with a very bright flame, being usually generated for that purpose by the action of water on calcium carbide, one pound of carbide yielding about five cubic feet of pure acetylene. The gas should not be subjected to a pressure over two atmospheres, and care should be taken in its use, as it is slightly poisonous.

Acetylene Generator.—A closed vessel in which acetylene gas may be continually produced by the action of water on calcium carbide, in quantities sufficient to supply a certain number of lamps, the gas being supplied under a uniform pressure. The generators are commonly made of small size to supply the lights for an automobile, bicycle, etc.

Achromatic.—Destitute of color; transmitting light without decomposing it into its constituent colors.

Acid.—1. Any sour substance, resembling vinegar in taste or effect; sharp and

biting to the taste; sour. Acid generally eats away or tarnishes metals and turns blue litmus paper red.

2. In chemistry, an acid always contains hydrogen, and this hydrogen is capable of being displaced by a metal, thus forming a salt. Some bodies are erroneously termed acids when they contain no hydrogen, but are *anhydrides* of the acid. *Carbon dioxide* is the anhydride of true carbonic acid.

Acid Process.—A term applied to both Bessemer and open hearth steel making processes, when the converters and furnaces are lined with ganister, firebrick or other siliceous materials, of acid nature. This was the original method, but was found to produce untrustworthy steel from ores which contained much phosphorus or silica; to remedy these shortcomings, the *basic process* was invented.

Acisculus.—A mason's small pick, with a flat face and pointed peen.

Aclinic.—In navigation, without inclination or dipping; said of the imaginary line near the earth's equator on which the magnetic needle balances itself horizontally, having no dip. The *acclinic line* is also termed the *magnetic equator*.

Acme.—1. The top or highest point; the culmination.

2. The crisis or height of a successful career.

Acoustics.—The science of sound; the study of the cause and phenomena of the vibrations which affect the organ of hearing, in other words, the manner in which sound is produced and its transmission through the air.

Acre.—1. A piece of land containing 160 square rods, or 4840 square yards, or 43560 square feet.

2. Any field of arable or pasture land.

Acrid.—Sharp and harsh, or bitter and hot to the taste; pungent.

Across.—From side to side; athwart; crosswise, or in a direction opposed to the *length*; quite over; as, a bridge laid *across* a river.

Act.—1. That which is done or doing; the exercise of power, or the effect of which power exerted is the cause; a performance; a deed.

2. To perform; to execute; to do.

3. To exert power; to produce an effect.

4. To fulfill functions; to put forth energy; to move; as, opposed to remaining *at rest*; to carry into effect; a determination of the will.

Actinometer.—An instrument for measuring the power of the sun's rays. One

use of the actinometer is to ascertain the proper time for exposing a plate in the camera. Also called *photometer*.

Action.—1. The putting forth or exerting of power.

2. The result of putting forth power; the thing done.

3. The exertion of physical or chemical force; the action of an acid.

4. In mechanics, the mechanism by means of which power is exerted in a machine; as, *single action* (that by which effective work is done in only one direction during a stroke), and *double action* (in which effective work is done on both the forward and return stroke).

Active.—Having the power or quality of acting; causing change; communicating action or motion.

Actual.—Something real or actually existing; carried out or realized in practice.

Actual Horse-power.—In steam engineering, the exact useful power given out by the engine; its amount is estimated by subtracting the power absorbed by the engine itself, from the *indicated* horse-power.

Acute.—Sharp at the end; ending in a sharp point; pointed.

Acute Angle.—Less than a right angle, or less than 90° .

Acute-angled Triangle.—One in which each angle is acute or less than a right angle, or under 90° .

Adamant.—A very hard mineral or metal, real or imaginary; a name given to the diamond and other substances of extreme hardness.

Adaptation.—The act or process of adapting or fitting, or the state of being adapted or fitted; *fitness*.

Adapter.—1. A glass tube open at both ends, and used to connect a retort with its receiver.

2. A receiver with two opposite necks, one of which admits the neck of the retort while the other is joined to another receiver. It is used in distillation to give more space to elastic vapors or to increase the length of the neck of a retort.

3. A tube to adapt or fit an accessory apparatus; as, to the body of a microscope.

Add.—To join or unite, as one thing to another, so as to increase the numbers, augment the quantity, enlarge the magnitude, or so as to form into one aggregate. Hence to *sum up*, to put together mentally.

Addendum.—That part of a tooth on a geared wheel outside the pitch circle. The circle passing through the tops of the teeth is called the *addendum circle*, and is equal in diameter to the blank or disc from which the wheel is to be cut.

Adding-machine.—An instrument or machine by which adding of numbers is effected.

Addition.—1. The act of adding; as, the addition of numbers to make a sum; the first ground rule of arithmetic.

2. In carpentry, anything added, as an annex to a house; a small building connected to another by one or more door openings. This is different from an *extension* as in the last, the parting wall is entirely removed.

Adept.—One fully skilled or well versed in anything; a proficient; as, he is an adept in his trade.

Adequate.—Equal to some requirement; proportionate; fully sufficient; as, powers *adequate* to a great work.

Adhere.—To stick fast or cleave, as a glutinous substance does; to become joined or united; as, *concrete adheres to the reinforcing steel*.

Adhesion.—The act or state of sticking, or being attached; the force with which distinct bodies hold together when their surfaces are brought in contact; as, of parts united by cement, and the like, or of parts pressed together, as a locomotive driving wheel and the rail.

Adhesive Power.—A term commonly used in connection with locomotive traction.

Adiabatic.—In physics, when a gas is compressed or expanded, if the heat due to compression be not taken away or fresh heat not supplied to make up for that lost by internal work during expansion, the compression or expansion is accompanied by a change of temperature, the gas becoming hotter or cooler than with *isothermal* expansion or compression.

Adiabatic Curve.—A curved line, as in an indicator diagram, exhibiting the variations in pressure and volume in a fluid which is expanded or compressed *adiabatically*, that is, without receiving or giving up heat. This curve differs from the hyperbolic or *isothermal* curve.

Adit.—An entrance into a mine, horizontal or nearly so, serving to drain off

water from the workings or to give access to the interior; generally known as a *tunnel*.

Adjacent.—Lying near, close or contiguous; neighboring; bordering on.

Adjoin.—To join or unite to; to lie contiguous; to be in contact with; to attach; to append.

Adjunct.—Something joined or added to another thing, but not essentially a part of it.

Adjust.—To cause to fit; make exact; to *adjust* the parts of a machine to a standard. Also the refitting or letting together of worn machinery parts so that their original relationships shall be preserved.

Adjustable.—Capable of being adjusted.

Adjusting-screw.—A set-screw of an instrument or tool by which one part is moved upon another either for focus, level, tension, or otherwise.

Admission.—1. The act or practice of admitting.

2. Power or permission to enter, entrance; access; power to approach.

Admission Line.—The side of the indicator diagram which shows the actual condition while steam is entering the cylinder.

Admission Port.—The passage by which steam enters the engine.

Admission Valve.—A valve controlling solely the supply of the working fluid, as in Corliss or Drop Valve steam engines and most gas engines, the exhaust being controlled separately.

Ado.—A shop term expressing unnecessary activity, bustle or fuss; as, much *ado* about nothing.

Adobe.—An unburnt brick. If well burned, the clay loses its plasticity, and cannot again be reduced to a mortar. If it be merely dried, it will assume its original condition, as it came from the *puig-mill*.

Adopt.—To take or receive as one's own what is not so naturally; to select and take or approve; as to adopt the view or policy of another; these resolutions were *adopted*.

Adrift.—In navigation, floating at random; in a drifting condition; at the mercy of wind and waves.

Adulterate.—To make impure by the admixture of other or baser ingredients; as to adulterate food or drugs.

Ad Valorem.—These Latin words signify "according to value," custom-house duties levied upon the *value* and not upon the *weight*.

Advance.—1. To bring forward; to move towards front; to make to go on.

2. To raise to a higher rank; to promote.

3. To bring to view or notice; to offer or propose; to show; as to advance an argument.

Advanced Ignition.—Setting the spark of an internal combustion motor, so that it will ignite the charge earlier. This is generally effected by turning the *contact break* on the half speed shaft so that it comes into earlier contact with the *ignition ram*. Turning the opposite way delays the spark and consequently the ignition. As the motor increases in speed, it is necessary to have an earlier spark so as to get a square admission corner on the indicator diagram.

Adze.—A carpenters' tool, suitable for chipping or for dressing timbers where a large amount has to be removed. The blade is curved or arched and the edge at right angles to the handle, thus permitting an advantageous stroke of the tool while the operator is standing over the work. The edge is beveled on the inside only, the handle being removed when necessary to grind the tool.

Aeolipile.—An antique form of reaction engine, attributed to Hero of Alexandria, in which the issuing steam from arms attached to a glass boiler or retort caused the latter to rotate upon an axis, after the manner of a pin wheel.

Aerated Waters.—Waters combined or charged with gas, usually with carbonic acid gas.

Aëriform.—Having the form or nature of air or gas. The prefix *aër*, in many words, signifies of or pertaining to the atmosphere or other gases.

Aërometer.—An apparatus for weighing and estimating the tension of air or other gases; an instrument for ascertaining the mean bulk of air or gases in pneumatic experiments.

Affinity.—In physics, the property or force by which differing elements or

groups of elements, when brought into contact, unite to form a new compound; chemical attraction.

Affirm.—1. To declare or assert positively.
2. To make a solemn declaration, before an authorized magistrate or tribunal, under the penalties of perjury; to testify by affirmation.

Affirmative.—That which affirms as opposed to that which *denies*; an affirmative proposition; that side of a question which affirms or maintains the proposition stated; opposed to *negative*.

Affluent.—A stream or river flowing into a larger river or into a lake; a tributary stream. Flowing to; flowing abundantly.

Afford.—1. To give forth; to supply, yield or produce as the natural result; as, olives *afford* oil.

2. To give, grant or confer with a remote reference to its being the natural result; to provide; to furnish; as, a good trade *affords* good wages.

Afloat.—1. Borne on the water; floating; on board ship.

2. Unfixed; moving without guide or control; *adrift*.

Aforethought.—Premeditated; previously in mind; designed.

Aft.—In navigation, at or towards the stern of a ship.

After.—1. Next, later in time; subsequent; succeeding.

2. In navigation, any object in the rear part of the ship, as, the *after* hatchway; *after* cabin.

After Blow.—In the Bessemer process, the continuation of the blast, after the iron has been decarburized, so that the phosphorus may be oxidized. This operation is apt to cause oxidation of the iron itself in the acid process, but not so in *basic Bessemer process*.

After Burning.—A defect in the working of internal combustion engines. The charge does not ignite instantaneously but sluggishly, and the combustion is prolonged causing a loss of power and imparting a series of shocks to the piston, instead of a single impulse. It is shown on the *indicator card* by a rounded or irregular admission corner and an undulating expansion curve, the crests denoting secondary explosions. Also called *back firing*.

After Cooler.—A species of surface condenser in which compressed air is cooled after compression, this having a refrigerating effect when the air is once more expanded. The use of the after cooler permits the compression to be more on adiabatic lines than when a waterjacket is employed.

After Damp.—A miners' term for the poisonous gases left behind after an explosion. They consist chiefly of *carbon dioxide*, of which ten per cent. in any atmosphere will cause asphyxiation, and of *carbon monoxide*, a deadly poison.

Again.—1. In return; once repeated, as, half as much again; half as large again.

2. Another time; once more; anew; as, the belt slipped off again.

Against.—1. Opposite to; facing; towards.

2. From opposite direction, so as to strike or come in contact with; upon; as, the hail beats *against* the roof; the tar paper is laid *against* the roof boards.

3. By or before the time that; in preparation for; so as to be ready for the time when.

Agate.—A form of free silica consisting of separate bands of quartz blended together, found principally in trap rocks and serpentine. It is regarded to some extent as a precious stone, and is used, on account of its hardness, as a material for burnishers, and is engraved to form seals, etc.

Ageing.—In dyeing and calico printing, a process for fixing the mordant in the fabric. The cloth travels continuously, over rollers arranged in vertical series, through a chamber heated to about 80° F., by means of radiant heat from steam pipes or hollow sides. The air is rendered moist by steam jets so that the fabric takes up five per cent. of its weight in moisture. The cloth takes about half an hour to pass through the machine, and is then piled in loose bundles in a warm moist atmosphere, and left for two or three days before the next process.

Agent.—One who, or that which acts for another; an active power or efficient cause of anything; as, a *chemical* or *physical* agent.

Aggravate.—1. To make heavy or heavier; to add to; to increase.

2. To make worse, or more severe, to render less tolerable or less excusable. to make more offensive.

Aggregate.—1. To bring together; to collect into a mass.

2. To add or unite, as a person to an association.

3. In physics, mass formed by the union of homogeneous particles.

Agitate.—To move with a violent, irregular action; as, the wind *agitates* the sea; to *agitate* water in a vessel.

Agitator.—1. In paper making, a vessel provided with paddles, in which the *stuff* or pulp is received from the beating engines and maintained in the proper state of fluidity for supplying the paper machine. Also termed *stuff-hest*.

2. In petroleum refining, a cylindrical vessel with a conical base, often of large size, holding 1000 tons or more. In it the illuminating oils etc., are agitated by means of compressed air jets, and treated meanwhile with sulphuric acid and then with alkaline solutions, for the purpose of removing free carbon particles, and the various matters which give the oil a dark color or an unpleasant smell. After agitating, the refined oil is thoroughly washed with water sprayed on the surface, and run out at the base; this is done either in the agitator or in a separate washer.

3. A stirring apparatus applied in many manufactories, as in the Bessemer process after the steel has been run from the converter into the ladle.

Agog.—In a state of eager curiosity or interest; *astir*.

Agree.—1. To harmonize in opinion, statement or action; to be in unison or concord; to be or become united or consistent; to concur.

2. To suit or be adapted in its effects; to do well; as, the outdoor position *agrees* with this man.

3. To be conformable; to resemble; to coincide; to correspond; as, the two scales *agree* exactly.

Agriculture.—The art or science of cultivating the ground, including the harvesting of crops, and the rearing and management of live stock; tillage; husbandry; farming.

Aground.—A nautical term used when a ship is fast on the bottom.

Aha.—A sunken fence, which is built in a trench, which prevents the passage of man and beast and at the same time does not obstruct the view of a beautiful landscape.

Ahead.—In navigation, forward or in front of a ship at an indefinite distance.

Aid.—1. Help, support, assistance; relief.

2. To support, either by furnishing strength or means in co-operation to effect a purpose; to help; to assist.

Aiguille.—A needle; among masons, a stone boring tool; a *priming wire*.

Aim.—To direct the intention or purpose; to attempt the accomplishment of a purpose; to try to gain; to endeavor.

Air.—1. The atmosphere which envelopes the earth.

2. The open space around and above the earth.

3. A gas consisting of a mechanical mixture of 23 per cent. of *oxygen* (by weight), 76 per cent. *nitrogen*, and 1 per cent. *argon*. Carbonic acid is present to the extent of about .03 or .04 per cent. of the volume. Obscure constituents are .01 per cent. *krypton* with small amounts of several other gases.

Air-bound.—This term applies to both pump and piping and expresses the confinement of air between the suction valve of the pump and the check-valve or the point of delivery.

Air Brake.—A continuous brake on a railway train worked by compressed air.

Air Brick.—In building, a brick perforated with openings so as to promote ventilation.

Air Circulation.—A system of cooling where air is passed over expansion or brine coils and then forced into the rooms to be cooled. The system is not adapted for producing very low temperatures, but an even temperature and a dry atmosphere can be successfully maintained.

Air Cock.—A cock controlling an air passage; practically the same as a pet cock. *Air cocks* are fitted to pump chambers, and all pockets where air can accumulate, and are often specified to be fitted to the highest part of marine boilers. They admit air while the boiler is emptying, and permit it to pass off when raising steam. A boiler can never be filled with water when *laying off* unless a cock is so fitted.

Air Compressor.—A machine, usually driven by steam, by which air is compressed in a receiver so that its expansion may be utilized as a source of power at distances where an ordinary engine could not be conveniently used.

Air Cooling.—The system of cooling an internal combustion engine-cylinder by directing air against its surface.

Air Cushion.—1. A rubber bag or bulb inflated with air, which is fitted upon a water pipe, to prevent shocks or water hammer occasioned by suddenly closing the cock or tap. The flexible bulb dilates under the blow and absorbs the shock.

2. A cushion of air compressed on the far side of the piston of a high speed single acting steam engine. This cushioning absorbs shocks at the release end of the cylinder and assists the engine to turn the center, promoting smoothness of running.

Air Drain.—In foundry, a passage left for the escape of gas from the mould on heavy castings.

Air Drill.—A rock-drill operated by compressed air.

Air Engine.—The action of air-engines consists of first compressing the air in the cold part of the cylinder, then transferring it to the hot part of the cylinder where it is quickly heated and expanded, thus furnishing the power. Some air-engines have a separate cylinder for compressing the air.

Air Extractor.—A sort of separator, with baffles and gratings, to strain the air from feed water as it passes to the boiler from a surface condenser. A trap float, or similar device is fitted to remove the air as it accumulates; warming the water before it reaches the pumps does away with the need of an air extractor.

Air Furnace.—A term denoting generally any furnace in which no artificial blast is employed. Reverberatory and brass furnaces therefore come under this designation.

Air Gate.—In moulding, an opening or vent for the escape of air or gases from the mould when pouring.

Air Gauge.—In hydraulic engineering, an instrument for ascertaining the pressure of air, as used in airlocks or caisson work.

Air Gun.—A machine impelling a bullet by compressed air; the trigger releases a spring behind the air chamber which suddenly compresses the air and discharges the missile.

Air Hardening.—A term applied to such tool steels as do not require to be quenched to harden them, but become hard by cooling gradually while exposed to the air, usually in a blast from a fan.

Air Lift.—A simple and effective method of raising liquids from wells, and bore holes. A pipe for compressed air is inserted down the middle of the pump tubing or rising main, and provided with a nozzle or ejector, at its lower end which directs an annular jet upwards through the space between the air pipes and the rising main. The depth to which the ejector must be placed is found by experiment, and depends upon the flow of the

water or oil through the strata, the height to be lifted, and the available pressure. Many water works, petroleum companies, etc., operate a large number of wells, by this means, from a central air compressing station.

Air Lock.—1. In hydraulic engineering, a pneumatic contrivance in a hollow caisson whose lower chamber is filled with compressed air to exclude the water. A trunk connects the submerged chamber with the external air and has two valves. The descending workman enters a chamber in the tube at the atmospheric pressure; the upper valve is closed, and his apartment is charged with air from the lower chamber, the lower valve is then opened to admit him to the working chamber.

2. In steam engineering, the double-doored communicating compartment between closed stokeholes under forced draught and the rest of the vessel, to avoid loss of air pressure.

Airpoise.—An instrument to measure the weight of air.

Air Pressure.—The pressure in a stoke-hole or closed ash-pit, under forced draught. It is measured in inches of water by a U gauge. One inch of water = 0.036 lbs. per square inch.

Air Pump.—1. A pump for exhausting, compressing or transmitting air.

2. A reciprocating pump, fitted to condensing steam engines whereby the water is drawn from the condenser together with any vapor or air liberated in the process.

3. A pump fitted to a locomotive used for compressing air in connection with continuous brakes.

Air-pump Barrel.—The cast iron snell of the pump, in which the bronze working liner is fixed, provided with chambers for the foot and head valves, if so fitted. In naval work, the barrel is usually of bronze or brass and the liner omitted.

Air-pump Governor.—In machinery, a contrivance applied to an air-pump to regulate the speed, so as to give a uniform pressure of air.

Air Reservoir.—One of the cylindrical tanks disposed beneath railway vehicles to contain compressed air for supplying the brake cylinders, air signals, etc.

Air Shaft.—1. A shaft sunk or used solely for ventilating underground workings. If two shafts be sunk, one on higher ground than the other and connected at their feet by a drift, the deeper shaft will act as a chimney, or *upcast shaft*, sucking air down the shallower or *down cast*.

2. In building, a well, formed within tenement or apartment buildings, for the purpose of admitting light and ventilation to inside rooms.

Air Ship.—A popular name given to any apparatus for aerial navigation. Though

generally denoting a *dirigible balloon*, the term is also extended to include *æroplanes*, which glide on kite like surfaces when pulled or driven; *ærodromes*, which glide on wings and manoeuvre themselves thereby, a balloon being generally employed to support part of the weight; and *ærowates*, in which the true future of aerial navigation lies, being frankly heavier than air, and depending upon power alone to raise them.

Air Signal.—A device fitted to passenger cars and locomotives as substitute for the bell-cord and communication cord formerly in use. It consists of an independent system of piping throughout the train which is supplied with air from the brake system through a reducing valve. On pulling a signal cord in a car, air is allowed to escape from the pipe in that particular car, and a small whistle is blown on the locomotive; the signal also acts in the event of the train parting.

Air-slaked.—Slaked by exposure to the air as *lime*.

Air Sollar.—In mining, a horizontal partition near the roof or floor of a heading, making an air passage for purposes of ventilation.

Air-space Insulation.—Still air, that is, air absolutely without motion, is a good non-conductor of heat; therefore, an air space is frequently constructed for that purpose in covering engine cylinders or insulating refrigerators. But, as a slight difference in temperature will set up air currents between the two sides, it has been found advisable to pack the space with some extremely porous or fibrous material such as sawdust, slag-wool or charcoal, which, although permeated with air, completely checks all motion.

Air-spaces.—In steam engineering, the openings between the fire bars of boilers are termed air spaces. It is essential that these should not be too contracted, else the bars will become unduly heated and twisted out of shape.

Air-tap.—In heating, a tap fixed in the air pipe in a hot water apparatus, to allow the escape of air from the series, which without this means of exit would accumulate therein. The air tap is placed at the highest point in the series of pipes. Air taps in pumps and engines are called *pet cocks*.

Air Thermometer.—As gases are more regular in their expansion than liquids, air is sometimes used in a thermometer bulb where small differences in temperature are to be measured with precision.

Air-tight.—So tight as to be impermeable to air; as, an air-tight cylinder.

Air-valve.—Any valve controlling the passage of air as used in connection with blast furnaces, gas producers, etc.

Air Vessel.—A cylindrical, globular or oval chamber fitted to pump deliveries, suction and long pipe lines, to promote an even flow. The air entrained by the fluid, is entrapped within the upper part of the vessel, forming an elastic cushion, which absorbs the shocks of the pump delivery, and by reaction, causes a subsidiary flow between strokes, thus rendering the delivery more uniform. Also termed *air chamber*.

Air-way.—A passage or conduit for flowing air; a ventilating gallery in a mine.

Aisle.—In architecture, a side division of a hall partially separated by columns from other entrances.

Alabaster.—A mineral; a white or delicately tinted fine grained gypsum; it is used in statuary, for carved ornaments, etc. In addition to the gypseous variety, a stalagmitic form of calcium carbonate is known as *Oriental Alabaster*.

Alarm.—An audible warning. Alarms, mechanically considered, are of many kinds; the purpose or construction of each is usually indicated by its name. They are placed in such positions or under such circumstances as to give warning of danger or to call attention; as, an *alarm clock*.

Alarm Clock.—A clock with a device connecting the scape wheel with a coil spring, which when it is freed will cause a bell to ring at any time required.

Albata.—A white metallic alloy which is made into spoons, forks, etc., also called *British plate* or *German silver*.

Albolite Cement.—This cement, of an entirely different nature from the natural and Portland cements, adheres to stone, wood, and dried oiled surfaces, but cannot be used for submarine work. It is a preparation adapted for ornamental mouldings and for repairing the face of worn out stone work.

Albumen.—The general term applied to those compounds containing carbon, hydrogen, nitrogen, oxygen and sulphur, forming the most important constituents of living animals and plants, and of these the *white of the egg* is typical.

Alcarraza.—A vessel of porous unglazed earthenware, used in hot climates for cooling liquids by evaporation from the exterior surface; it is a Spanish word.

Alcohol.—Pure or highly rectified spirit, extracted by simple distillation from

various vegetable juices and infusions of a saccharine nature, which have undergone vinous fermentation; the spirituous or intoxicating element of fermented liquors. In commerce ethyl alcohol from maize or other grain is called *grain alcohol*, etc. For industrial purposes, alcohol may be obtained from almost any source, potatoes, beet-root, corn, vegetable refuse, etc., which is first converted into sugar and then fermented by the action of malt and yeast. Alcohol is used as a solvent in nearly every industry, and also as a fuel for cooking, in lamps, and for internal combustion engines.

Alcohol Engine.—An engine in which the vapor of alcohol is used as a motive power.

Alcoholometer.—A hydrometer used for determining the strength of spirituous liquors, that is, the proportion of pure alcohol which they contain. The graduation of the scale is from zero to 100°, pure distilled water giving the former reading and absolute alcohol, the latter. It differs from a *Beaume* hydrometer only in the graduation of the scale.

Alcohol Thermometer.—A thermometer, especially suitable for low temperatures, in which alcohol or spirits of wine replaces mercury.

Alcove.—In architecture, a recess separated from a main chamber by columns, and balusters; a recess in a room for a bed or for seats.

Alder.—A large shrub or small tree. It is very soft and light, hence is used for charcoal making in connection with gunpowder; its durability under water is great and thus it is employed in the manufacture of sluices and other submerged work. The *bark* is used with copperas in dyeing black.

Alee.—In navigation, on or toward the lee, or the side away from the wind; the opposite of *aweather*. The helm of a ship is *alee* when pressed to the lee side.

Alembic.—A distilling apparatus of glass or copper made in two parts, the lower a bulb or vase to contain the liquid, and the upper fitting into it and provided with a neck to carry away the vapor. It is practically superseded by the *retort*.

Alette.—In architecture, a wing of a building; a buttress or pilaster.

Algebra.—A mathematical science in which letters, signs and figures are employed in making calculations, instead of figures alone, as in arithmetic. By the aid of this highly systematized notation, it is possible to express obscure or involved quantities, which are set down as *equations* and the problem solved by treating the equations according to

certain definite rules. The science of algebra may be regarded as the *analysis of equations*.

Algebraic Operation.—The combining of quantities according to the principles of algebra.

Alias.—A term used in legal proceedings to connect the different names of any one who has gone by two or more, and whose true name is, for any cause, doubtful.

Alibi.—The mode of defense under which a person on trial for a crime, proves or attempts to prove that he was in *another place* when the alleged act was committed.

Alien.—Not belonging to the same country, land, or government, or to the citizens or subjects thereof; foreign; as, *alien subjects*.

Align.—To arrange, place or form *in line*; as, to line shafting. Also spelled *aline*.

Alignment.—1. The line to which adjustment is made, or the things arranged in line.

2. The drawing of an imaginary straight line through two or more points or objects.

3. The ground plan of a work; as, in railroad engineering.

Aliquant.—An aliquant part of a number or quantity is one which does *not* divide it without leaving a remainder; thus, 5 is an *aliquant* part of 16.

Aliquot.—In arithmetic, contained in something else an exact number of times; as, 6 is contained in 24 *exactly* 4 times.

Alive.—1. In a state of action; in force or operation; unextinguished; unexpired; existent; as, to keep the fire *alive*.

2. Sprightly; lively; brisk.

Alizarin.—A red coloring matter formerly obtained from the *madder* plant, but now prepared on a large scale from *anthracene*, one of the products of coal-tar distillation.

Alkali.—Chemically, a substance which yields *hydroxyl*, on being dissolved in water. The characteristics of alkalis are a caustic taste; the neutralization of acids, forming a salt and water by the process; and turning red litmus paper *blue*. The chief alkalis, all made and used in enormous quantities, are:

ammonia, often termed *volatile alkali*; potassium and sodium hydrates, the two *caustic alkalis*; sodium and potassium carbonates; quicklime or calcium oxide.

Alkalimeter.—The object of this instrument is to ascertain the value of the alkalis of commerce. The strength of alkali is inferred from the amount of acid required to neutralize it.

Alkaloid.—A basic nitrogenous substance, resembling an alkali in its properties; the alkaloids are of vegetable origin and generally possess remarkable physiological action, as they include such substances as morphine, nicotine, quinine, strychnine, caffeine, etc. Most of them are of unknown constitution.

All.—The whole quantity, extent, duration, amount, quality, or degree of; the whole; the whole number of; every; as, *all the land, all the strength.*

Allan Link.—A form of *link-motion* in which a straight link is used, and the reversing motion is applied half to the valve radius rod, and half to the link, thus requiring a smaller travel of gear. It is fitted to steam-engines which have to be reversed frequently, especially those in *rolling mills*.

Allay.—To quiet or put at rest; to pacify or appease; to quell; to calm; as, to *allay* popular excitement.

Allen, Horatio.—Born at Schenectady, N. Y., May 10, 1802. Died Dec. 31, 1889. He was graduated from Columbia College in 1823. His chief title to popular regard lies in the fact that he acted as engineer on the trial trip of the first practical locomotive in America, the "Stourbridge Lion." He was early recognized as an accomplished Civil Engineer, and a most productive factor in the pioneering of American Railroads. His first important connection was with the Delaware & Hudson Canal Co., and brought about the importation of the first locomotive in America, which was built in England under his direction and made its initial trip under his personal control, thus securing for him fame as "the engineer of the first locomotive in the country." Mr. Allen retired early from the special field in which he exerted so useful an activity though he continued to carry on his profession for many years and had much to do with railroads as a director and executive officer. Mr. Allen became connected with the Croton aqueduct in New York as principal assistant engineer, and among other things had charge of the construction of the High Bridge over the Harlem river. He was first President of the Erie R. R.; Pres. Am. Soc. C. E., 1872-3.

Alleviate.—To lighten or lessen physical or mental troubles; to mitigate, or make easier to be endured.

Alley.—1. A small passageway between buildings.

2. In printing, the compositor's standing place between two opposite frames.

Alligation.—In arithmetic, a rule for finding the relation between the prices of the ingredients in a mixture, their proportions, and the price of the mixture.

Alligator.—In mechanics, any machine with strong jaws, one of which opens like the movable jaw of an alligator; as, in metal working, a form of *squeezer* for the puddle ball; in mining, a form of rock breaker; in printing, a small job press.

Alligator Squeezer.—In a forge, a *shingling* machine for squeezing slag and dross out of the wrought iron bloom. Two massive L-shaped pieces are pivoted on each other, the horizontal parts forming two serrated jaws, resembling those of the alligator while the lower parts are operated by gearing and toggle joints. The ball is placed between the jaw and gradually worked up to the apex of the V, as its impurities are crushed out. Many ironmakers prefer the alligator to a steam hammer.

Alligator Wrench.—A solid wrench with V-shaped jaws, one or both of which are notched or *serrated*, so that a firm grip may be secured on irregular or cylindrical pieces which are to be turned.

Allotment.—That which is allotted; a share; part or portion granted or distributed; that which is assigned by lot; anything set apart for a special use or to a distinct party.

Allotropy.—In chemistry, power possessed by certain elements of existing in more than one form. Carbon exists as the diamond, graphite and charcoal. Oxygen, has an allotropic form as *ozone*, in which the atoms are condensed; *phosphorus* is also existent in two very distinct forms, the yellow and red, whose properties vary widely.

Allow.—1. To grant; give; admit; accord; afford; yield; to let one have; as, to *allow* a free passage.

2. To accept as true; to concede.

Allowance.—A share or portion allotted or granted; a sum granted as a reimbursement; a bounty; as, an appropriation for any purpose; a stated quantity, as of food or drink; hence a limited quantity of meat and drink when provisions fall short.

Alloy.—1. A compound of two or more metals formed by fusion, as of copper and tin to form gun metal. When mercury is one of the constituents the resulting metal is termed an *amalgam*.

2. The admixture of a baser metal, such as copper, with gold or silver in coinage, to give the necessary hardness to the nobler metal.

Alluvial.—Pertaining to, contained in, or composed of, alluvium; relating to the deposits made by flowing water washed away from one place and deposited in another.

Alluvium.—Recent deposits of sand, gravel or mud; land formed in river valleys from silt carried by the stream.

Almanac.—A book or table, containing a calendar of days, weeks and months, to which astronomical data and various statistics are often added, such as the times of the rising and setting of the sun and moon, changes of the moon, eclipses, hours of full tide, etc., etc.

Almond Furnace.—A refining furnace used for separating all kinds of metals from cinders, etc. The term is a corruption from *allemand* or Germany.

Almond Stone.—A mineral. An iron-alumina garnet. When of a fine deep red, or purplish red, from India, and transparent it is "precious garnet."

Almost.—Nearly, well nigh; all but; for the greatest part.

Alpaca.—In textile manufacture, a cloth in which the wool of the alpaca is combined with wool, silk or cotton.

Alpha.—1. The first letter of the Greek alphabet, answering to A and hence used to denote the *beginning*.

2. Also often used to denote the chief, superior, etc., as, in the trade-mark of cement, *alpha* cement is the first kind of Portland cement made in America.

Alphabet.—1. The letters of a language arranged in the customary order; the series of letters or signs which form the elements of written language.

2. The simplest rudiments; elements.

Alphabet Telegraph.—An apparatus which marks symbols on paper by pressure, or by chemical action, or impresses type on paper; in contradistinction to one whose indications are observed by the fluctuating position of a needle or needles.

Already.—Prior to, or before some specified time; either past, present, or future; by this time; previously.

Also.—1. In like manner; likewise.

2. In addition; besides; as well; further; too.

Altar.—1. In a furnace, the low ridge which intervenes between the puddling-heart and the stack.

2. In shipbuilding, one of the steps at the side of a graving dock. The steps are from nine to sixteen inches in height, and from nine to fifteen inches wide, except the *broad altar* which is eighteen inches wide.

Alter.—1. To make otherwise; to change in some respects; either partially or wholly; to vary; to modify.

2. To agitate, to affect mentally.

Alternate.—1. Being or succeeding by turns; one following the other in succession of time or place; by turns, first one then the other; hence, *reciprocal*.

2. Designating the numbers, in a series, which regularly intervene between the numbers of another series, as the odd or even numbers of the numerals; every other; every second; as, the alternate numbers, 1, 3, 5, 7, etc.

Alternating.—Moving or flowing by turns in opposite directions; acting successively in two manners or by two methods, first one and then the other, then the first again.

Altiscope.—This invention consists of an arrangement of lenses and mirrors in a vertical telescopic tube, by means of which a person is able to overlook objects intervening between himself and the object he desires to see, used especially for military purposes. A portable altiscope is made in the form of a cane or walking stick, provided with slides, covering the openings when not in use, and then appearing as an ordinary cane.

Altitude.—1. The height or perpendicular elevation of an object above the ground, or above a certain level. The *altitude* of any place is usually referred to a *datum level*, such as high water mark, or the surface of a particular piece of water.

2. In navigation, the angle between a star, or other heavenly body, and the horizon, measured in degrees of a vertical circle.

3. In geometry, in a polygon, the perpendicular distance between the base and the side, or angle opposite the base.

Alto-rilievo.—The high relief of a sculptured object from the plane surface to which it is attached. The degrees of prominence of the object, are indicated by the terms, *alto*, *mezzo* and *basso*.

Alum.—A double sulphate of potassium and aluminum, found native or else

made from aluminum sulphate (from bauxite) potassium chloride, and potassium sulphate. It is very astringent, being used for that purpose in medicine; is employed as a mordant in dyeing and calico printing and as an adulterant to whiten bread. Alum prevents fermentation and makes the bread white, thus permitting the use of inferior or damaged flour.

Alumina.—The chief constituent of all clays, and widely and abundantly diffused over the globe. It is naturally a pure white unshapen substance and the basis of *alum*.

Aluminous Bricks.—In furnaces, fire bricks whose basis is alumina. They are employed in those portions of hearths and furnace-linings where contact between the bricks and metallic oxides would occur; silica bricks being unsuitable for use in these situations.

Aluminum.—A metal of a silvery white color; much used for telescopes, cooking utensils, soldiers' accoutrements, etc., on account of its lightness, also in alloys with copper to form a tenacious non-corrodible bronze. It abounds in nature in the form of hydrates and silicates, the latter comprising the various clays, but is commercially prepared by the aid of electricity from cryolite and bauxite. The metal is not corroded by atmospheric influences or fresh water, also resisting nitric acid, but is decomposed by alkalies, in sea water, and by dilute sulphuric acid; it is malleable, ductile and sonorous, also a good conductor of heat and electricity.

Aluminum Bronze.—A beautiful golden-colored bronze, composed of 90 parts copper to 10 of aluminum. Its tenacity largely depends upon the purity of the copper from which it is alloyed, tests having given a tensile strength of 73,185 lbs., *minimum*, to 96,280 lbs., per square inch, the average figures far nearer the second figure than the first. A compressive strength of 132,000 lbs. per sq. in. has been obtained. Aluminum alloys are now used for many purposes where lightness is a necessity.

Alum Shale.—Clay slate, containing iron pyrites, the decomposition of which leads to the formation of alum.

Alundum.—Artificial corundum made in the heat of an electric furnace; used as an *abrasive*.

Always.—Constantly during a certain period, or regularly at stated intervals; uniformly the same.

Amalgam.—A combination of mercury or quicksilver with other metals.

Amalgamation.—In smelting, the act of combining with mercury; specifically, the process in which pulverized ores of

gold and silver are passed over pans containing mercury, which dissolves the precious metal from the rock. The resulting *amalgam* is subjected to heat in a suitable retort, when the mercury distills off, leaving the gold or silver behind.

Amalgamation Plates.—In gold mining, copper plates filled with mercury placed in sluice boxes, etc., to extract gold or silver from crushed ore streamed over them.

Amalgam Gilding.—The process for making and applying this is as follows: grain gold, 1; mercury 8; unite by gentle heat and stirring. In using, first rub the brass, copper, etc., with a solution of nitrate of mercury, and then spread a film of amalgam. Heat volatilizes the mercury and leaves the gold behind.

Amalgam Varnish.—Melt grain tin, 4; bismuth, 1; add mercury, 1; and stir till cold. Grind fine with white of egg or varnish.

Amass.—To collect into a mass or heap; to gather a great quantity of; to accumulate; as, to *amass* a fortune.

Amateur.—A person attached to a particular pursuit, study, science or trade, from taste or attachment without pursuing it to make a living.

Amber.—A yellowish translucent resin resembling copal, found as a fossil in alluvial soils, with beds of lignite, or on the seashore in many places. It takes a fine polish and is used as a basis for a fine *varnish*.

Ambergris.—*Gray amber* so called to distinguish it from yellow or true amber. Ambergris is a slate colored solid, lighter than water, which is secreted in the intestines of the sperm-whale. It is found floating on the sea or is washed up on the beach; its consistency is greasy and it emits a delicate perfume when heated.

Ambidextrous.—Having the ability of using both hands with equal ease or skill; very dextrous or skillful.

Ambiguous.—Doubtful or uncertain, particularly in respect to signification; capable of being understood in either two or more possible senses; equivocal; as an *ambiguous* course.

Ambulator.—1. A wheel, with a recording instrument attached, propelled by hand, as for surveyor's measurements.

2. A velocipede propelled by pushing on the ground with the feet, alternately.

Amicable.—Friendly; proceeding from, or exhibiting, friendliness; after the manner of friends; as, an amicable disposition or arrangement.

Amiss.—1. Astray; faultily; improperly; wrongly; ill.
2. A fault, wrong or mistake.

Ammeter.—A contracted form of *ampère-meter*. This is an instrument for measuring the ampères of an electric current, thus registering the strength and consequently the quantity of current passing.

Ammonia.—A colorless gas with a characteristic pungent odor (hartshorn), and a marked alkaline taste. It has a specific gravity of 8.5 (hydrogen being 1) and is lighter than air. It burns in oxygen, producing water and nitrogen, and is a powerful base, combining with all acids to form salts. Ammonia is easily liquefied at ordinary temperatures, a pressure of seven atmospheres being sufficient; it is also the most soluble of gases, one volume of water dissolving over 800 volumes of it at ordinary temperature. It is most commonly met with in its aqueous solution, the strongest commercial quality having a specific gravity of 0.880, being known as *380 ammonia*. Ammonia probably derives its name from the fact that the first ammonium salts were prepared from the offal of camels, near the famous temple of A-men (*Jupiter Ammon*) in Ancient Egypt. It is obtained on a commercial scale by boiling the ammoniacal liquor of gas works with milk of lime, or recovered from the by-products of blast furnaces and coke ovens.

Ammoniacal Liquor.—An aqueous solution of numerous complex substances, of which ammonia is the base; it collects in the condensers and scrubbers during the manufacture of illuminating gas from coal, and hence is also known as *gas liquor*. Some of the ammonia compounds are volatilized along with the free ammonia by boiling the liquor. Others are removed by boiling with milk of lime. The most important products of gas liquor are *sulphate of ammonia*, a valuable fertilizer, and various *ferrocyanides*, especially useful in the cyanide process of recovering gold from slimes and tailings.

Ammonia Charge.—In refrigerating, the amount of ammonia, anhydrous and aqua, which is put into an absorption or compression machine as its working force.

Ammonia Compressor.—A machine in which the ammonia gas, or anhydrous ammonia, is compressed to a liquid. It is absolutely necessary to construct these compressors with the minimum of clearance, so as to expel all the ammonia at each discharge stroke, as any left behind would expand during the suction stroke, and destroy the efficiency of the apparatus. This imperative condition is responsible for the points of design in which the ammonia compressor departs from that used for compressing air.

Ammonia Dryer.—In refrigeration, a vessel containing trays of quicklime, through which the gas is passed occasionally to free the ammonia from water. It is fitted as a by-pass on the suction side.

Ammonia Ice Machine.—A refrigerating apparatus for the production of artificial ice, either by the *absorption* or *compression* processes.

Ammonia Joints.—All joints should be made of wrought iron or steel, as ammonia attacks and eats away copper and its alloys, brass and gun-metal. In consequence of the penetrating nature of ammonia, all flanges should be screwed and then soldered on the iron pipes, while lead washers should be used for gaskets on all flange joints. Lead or white metal packing must also be used for all valves.

Ammonia Liquor.—The aqua ammonia in the various parts of an absorption machine when in use, varying in strength from *weak* to *strong* liquor.

Ammonia Pump.—In an *absorption machine*, a small steam pump, placed between the heat exchanger and generator, whose duty is to draw the strong ammonia liquor from the absorber and force it into the generator.

Ammonium Chloride.—Also known as *sal ammoniac* and as *muriate of ammonia*. A white solid obtained whenever hydrochloric acid and ammonia are brought together; it is usually produced by neutralizing the distillate from ammoniacal gas liquor with this acid, concentrating the resulting liquid. It is also found in volcanic deposits, and was the first ammonium salt discovered.

Ammonium Sulphate.—An ammonium compound, derived from the ammoniacal liquor of gas works, which is boiled with slaked lime to free it from its combined ammonia gas; this gas is then received in sulphuric acid and converted into the sulphate of ammonia. The latter is largely used as a fertilizer, and is the commercial source of nearly all the other ammonia salts.

Ammunition.—In mechanics, this word is applied to a quantity of dynamite sticks which are used in large engineering enterprises for *rock blasting*.

Amongst.—1. Mixed or mingled with; surrounded by.

2. Conjoined, or associated with.

Amorphous.—Without determinate shape; structureless; unshapen; unshapely; as *amorphous* slag, rock, etc.

Amphitheatre.—In architecture, a *double theatre*. An elliptical or circular structure representing two classical theatres placed together. Instead of a stage, there is a central space, the *arena*, so called from its being strewn with sand; this is at a lower level than the first row of seats.

Amplitude.—1. In *physics*, the amount by which a vibrating body is displaced on either side of its position of rest, as a pendulum swinging through a distance of seven inches is said to have an *amplitude* of $3\frac{1}{4}$ inches, the distance it moves either side of the central position.

2. In *astronomy* and *navigation*, the angular distance on the horizon from the east or west point.

Amygdaloid.—A trap rock of igneous origin and complex structure, deriving its name from little almond-like pits of softer material found throughout the mass. In the Lake Superior region, copper-bearing amygdaloids frequently show native copper in these pits or *amygdules*.

Amyloid.—Like starch. In chemistry, the gummy substance formed by the action of sulphuric acid on cellulose.

Analysis.—1. In chemistry, the resolution of a compound into its parts or constituent elements. Such analysis may be *qualitative*, showing the nature of the various bodies only, proving their presence by tests; or it may be *quantitative*, in which the exact proportions of the different constituents are ascertained by a series of refined eliminatory processes accompanied by weighing on delicate balances.

2. In mathematics, the process of resolving a problem into its elements, especially in dissecting an equation.

Analytical Geometry.—Geometry treated and discussed by means of algebra, with direct or indirect reference to a system of co-ordinates, by which the spaces and points are assigned to their correct relations with each other.

Analyze.—To resolve anything complex into its elements; to separate into the constituent parts, for the purpose of an examination of each separately; to examine in such a manner as to ascertain the elements or nature of the thing examined.

Analyzer.—In refrigeration, a part of the *absorption* apparatus; sometimes forming the upper portion of the generator, but generally a separate vessel. In either case, it contains many cast iron trays or baffles to

riddle out suspended watery particles from the ammonia gas and return them to the *rich liquor*. This action is assisted by the rich liquor from the absorber, which flows over these trays on its passage to the generator, washing the aqueous particles from the gas and enriching the latter, and having its own temperature raised before it reaches the boiling liquor.

Anchor.—1. A hooked implement of iron or steel, varying as to form, which, being attached to a cable is dropped overboard to secure a floating vessel to the bottom.

2. In steam ploughing, a heavy vehicle on which is mounted a sheave or pulley for the endless wire used with a single engine, and serving to maintain the tension on that wire from the opposite side of the field. The sheave also actuates gearing which, hauling in a rope, pulls the anchor up the field as the plowing progresses.

3. In suspension bridges, the device by which the ends of the cables are secured, either in masses of masonry or in the solid rock.

4. To fix, secure or hold fast; as, by an anchor.

Anchor Bolts.—Bolts used for securing structures and machines to their foundations. They are furnished with large plates of various forms, or *anchors*, which afford the necessary attachment on being buried in the ground or under the mass of masonry built around the bolts.

Anchor-Buoy.—Small buoys of wood or cork, painted a conspicuous color, which are attached by a thin line to a ship's anchor when it is let go, thus serving to denote, as they float on the surface, the locality where the anchor lies.

Anchor-gate.—In hydraulics, a heavy gate, used in the locks of canals; it requires for its upper bearing, a collar which is stayed by the adjacent masonry. Barbed metallic projections from the collar are embedded in the masonry, and resist displacement of the gate while enduring strain or swinging on its axis.

Ancon.—In architecture, an elbow-shaped projection, as a bracket or corbel; the corner or quoin of a wall.

Ancony.—In metal working, a wrought iron bar, partly finished in the middle, but unwrought or left larger at the ends.

Encove.—In building, a console on each side of a door to support a cornice or entablature.

Andiron.—A utensil for supporting wood when burning in a fire-place, one being placed on each side; a fire-dog; as, a pair of andirons.

Anemometer.—An instrument for measuring and registering the velocity and direction of the wind.

Anent.—About; concerning: in respect to; as, he said nothing *anent* this particular operation.

Aneroid Barometer.—An instrument for indicating atmospheric pressure. The action of the aneroid depends on the pressure of the atmosphere on a circular metallic box hermetically sealed and having a slightly elastic top, the vacuum serving the same purpose as the column of mercury in the ordinary barometer.

Anew.—Over again; another time; in a new form; afresh; as, to turn *anew*; to build *anew*.

Angle.—1. A point where two lines meet; a corner.

2. The difference in the direction of two lines proceeding from the same point, usually expressed in degrees.

Angle Bar.—1. Angle iron.

2. In building, an upright bar at the angle where two faces of a bay window meet.

Angle Bead.—In carpentry, a strip having a rounded edge, and placed at the vertical exterior angle formed by plastered surfaces. A *beaded edge angle staff*.

Angle Bracket.—In carpentry, one beneath the eave at the corner of a building, and projecting at an angle of 45° with the face of each wall.

Angle Float.—In building, a plasterer's trowel, made to fit internal angles of the walls of a room.

Angle Gear.—An arrangement of bevel gearing whereby it is possible to drive a shaft at other than a right angle with the driver, through the interposition of a third miter wheel.

Angle-iron.—A rolled bar of iron or steel of a section resembling the letter L; used for forming the edges of iron structures or the framing of the same; or to be riveted to the corners of boilers, tanks, etc. connecting the side-plates.

Angle-joint.—A joint formed by two pieces of material meeting at an angle, differing according to the material, thickness, purpose, and exposure; as, *miter, butt, lap, around, and folded angle-joint*.

Angle of Clearance.—In machine shop practice, the angle to which the heel of a machine tool is ground away, so as to clear the work and present the cutting edge at the proper angle; also known as *bottom rake*.

Angle of Cutting Tools.—In tools, these are measured between the surfaces of the materials upon which they operate and their cutting faces. They vary from about fifteen degrees as in spokeshaves to one hundred and twenty degrees.

Angle of Entrance.—In navigation, the angle which the bow of a vessel makes with the water at the water-line.

Angle of Repose.—The greatest angle with the horizontal at which a mass of material, as in a cut or embankment, will lie without sliding. Also called *angle of friction*.

Angle of Rupture.—The angle at which any material, as iron or wooden beams, will break, upon the application of sufficient stress or strain.

Angle of Traction.—In physics, the angle made with a given plane by the line of direction in which a tractive force acts.

Angle Plate.—1. A cast iron bracket or angle planed accurately to a right angle, which is used for chucking objects such as valve bodies, tee pieces, etc., on the face plate of a lathe.

2. A plate rolled or cast with one edge at right angles to the remainder, thus obviating the need of an angle bar; much used in structural engineering.

Angle-Valve.—A stop-valve whose outlet is at right angles to its inlet branch, thus combining in itself a valve and an elbow.

Angular.—Possessing or relating to an angle or angles; pointed; sharp cornered; as, an angular box.

Angular Advance.—A term relating to steam engine valve gear. It is the acute angle made by a line passing through the center of the shaft and center of the eccentric, with a line passing through the center of the shaft and perpendicular to the line joining the center of the shaft and the center of the crank pin. Its magnitude depends on the lead and outside lap of the valve.

Angular Measurement.—This is generally expressed as degrees, ($^{\circ}$), minutes ($'$), and seconds ($''$), as $7^{\circ} 18' 22.6''$; each circle being supposed to be divided into 360° .

Angular Thread.—A screw thread whose cross section is that of a triangle, as distinguished from a *square thread*.

Angular Velocity.—In mechanics, the speed of a turning body, or one revolving in a vertical plane; as, a shaft or crank; usually described in circular measure, or as the angle through which a radius passes in one second of time. Thus a wheel making 3 revolutions per second would have an angular velocity of 360×3 degrees, $2\pi \times 3.1416 \times 3$ radius.

Anhydride.—A class of chemical compounds which are regarded as molecules of water from which the hydrogen has been taken and substituted by an acid or basic element.

Anhydrous.—In refrigeration, containing no water, or freed from any water that it might have contained.

Anhydrous Ammonia.—In refrigeration, ammonia freed from any water which it might contain; as, the dry gas leaving the analyzer of an absorption refrigerating apparatus.

Anhydrous Tar.—In blast furnaces, tar which has been boiled to expel the water. It is mixed with burnt magnesia lime stone to form a paste for the lining of Bessemer converters.

Anicut.—A dam or mole made in the course of a stream for the purpose of regulating the flow of a system of irrigation.

Aniline.—A powerful base or alkaline substance prepared from nitrobenzene by the action of iron filings and acetic acid. The nitrobenzene, which is used by soap-makers to give the perfume of almonds, is in turn derived from coal tar distillates by the action of nitric acid. Subjected to the action of various oxidizing bodies, aniline produces a great number of colored products, the aniline dyes so much used in the manufactures for coloring textiles, paper, inks, soaps, etc. As first produced, aniline is a colorless liquid, slightly heavier than water, which assumes a brownish tinge on exposure to the air.

Animal Charcoal.—A form of structureless carbon obtained by heating bones out of contact with air. It possesses high power of decolorizing, and is much used for that reason in the arts and manufactures. Also sold commercially under the names of *animal black*, *bone black*, *ivory black*, for use as a pigment.

Animal Oils.—Lubricating oils for machinery obtained from animal tissues, the principal being sperm, ordinary whale, neatsfoot, seal. The animal oils do not dry and therefore do not gum, but they decompose and generate fatty acids which corrode metal work with which they come in contact and produce also residual deposits; as, in steam boilers.

Animal-power.—The power of horses, oxen, etc., as distinguished from steam-power, man-power, etc.

Animals.—In the language of the mechanical arts, the names of animals have not been entirely overlooked as:—*Beetle*; *Bulldog*; *Cock*; *Cow*; *Crane*; *Crab*; *Frog*; *Horse*; *Monkey*; *Ram*; *Worm*; etc.

Anna.—An East Indian money of account, the sixteenth of a rupee, or about $2\frac{1}{2}$ cents.

Annals.—1. A relation of events in chronological order, each event being recorded under the year in which it happened.

2. A periodic publication, containing records of discoveries, transactions of societies, etc.

Annatto.—A yellow dyestuff obtained from the seeds of a tropical plant, indigenous to the West Indies. It is used to strengthen ordinary yellows, or serves alone as a dye for textiles and glove leather.

Annealing.—1. The process of gradually cooling carbon steel after gradually heating it, so as to render it soft for working, the metal being usually protected from contact with the air. In hard steel the carbide of iron or *cementite* is in solution; in pure iron heating causes the *cementite* to separate from the solution, and annealing permits the two constituents to remain separate, thus giving soft steel. The act of *drawing the temper* to colors, is in a sense, a partial annealing of steel already hardened.

2. In foundry work, a term applied to the treatment of large clay or loam cores, which are baked or burnt in a furnace, and then slowly cooled.

Annealing Arch.—The oven in which glassware is allowed to cool gradually in order to anneal it; it is called a *leer* in some departments of glass making.

Annealing Furnace.—A furnace in which metals are heated nearly to fluidity, and then allowed to cool slowly, so as to render them less brittle or to make them malleable; or, as with glass, a furnace in which the heat is retained for a considerable period in order that the process of cooling may be protracted.

Annealing Iron.—A plate provided with receptacles for holding assaying specimens when they are annealed after flattening and rolling.

Annealing Oven.—A chamber in which articles are placed to allow them to cool gradually so as to make them tough.

Annealing Pot.—A closed pot set in a furnace, and used for exposing an object to heat without forming a scale of oxide. Pots for annealing wire are made annular, so as to receive, with as little vacant space as possible, the wire which is coiled therein. The smaller the amount of air in the closed pot, the less the deterioration of the wire by exposure of its heated surface.

Annex.—1. To join or attach ; usually to subjoin ; to affix ; to append.

2. To join or add ; as, a smaller thing to a greater.

3. To connect ; as, a consequence, condition ; etc.

4. Something annexed or appended ; as, a subsidiary building to a main building.

Annual Rings.—In timber, the circumferential layers of wood seen in a cross section of timber, and which represent the yearly additions to the woody fibers. In good timber the rings are narrow and closely packed, in inferior woods, they are wide and open, estimated of course relatively to the yearly growth of the particular timber under consideration.

Annuity.—A definite sum of money paid each year or *annually*. When the sum is paid yearly for a specified term of years as 15 or 20, it is termed a *certain annuity*, when paid for an uncertain period depending upon various contingencies, it is a *contingent annuity*; when extending over one or more lives, it is denominated a *life annuity*.

Annul.—1. To reduce to nothing ; to obliterate.

2. To make void or of no effect ; to nullify ; to abolish ; to do away with ; to destroy ; reverse ; to cancel.

Annular.—1. Pertaining to, or having the form of a ring ; forming a ring ; ringed ; ring shaped.

2. Banded or marked with circles.

Annular Bit.—A boring bit which cuts a circular channel, but does not rout the central portion. Wads, buttons and some other things, are made by a tool of this kind.

Annular Borer.—A rock boring tool, which makes a circular groove in the stone and leaves an axial stem of un-

bored matter. The tool descends until the stem is nearly as long as the wings of the tool, then the latter being withdrawn, a grapnel is introduced into the hole, the stem broken and raised. The borer is then re-lowered and the work proceeds.

Annular Engine.—In steam engineering, a steam engine, the cross section of whose cylinder is that of a ring, the piston being also annular in plan. Being of this form, therefore, there are two cylinders, the outer or working one, and the inner cylinder, within which works the cross-head to which the lower end of the connecting rod is attached. The connecting rod passes thence upwards to the crank overhead. The communication between the piston and the cross-head is made by two rods passing to prolongations of the cross-head above. The advantage of this engine is the possession of a long connecting rod in a restricted space.

Annular Gear Wheel.—A toothed wheel, formed like an annulus or ring, with the teeth on the inner circumference.

Annular Space.—The ring-like space contained between two concentric circles or cylinders.

Annular Valve.—A flat or circular valve with a central hole.

Annulet.—In architecture, a small, flat fillet, encircling a column, etc., used by itself, or with other mouldings. It is used several times repeated under the *Doric capital*.

Annulus.—1. In geometry, the space contained between the circumferences of two circles, one within the other.

2. In physics, the solid formed by a circle revolving around a line which is in the plane of the circle but does not cut it.

Annunciator.—In buildings, a fitting attached to an electric or pneumatic bell system, in which a shutter, falling in one of a series of windows in a frame, discloses the name or number of the apartment, etc., whence the call by bell has been made.

Answer.—A reply or response, especially one that is sufficient, as, the *answer* to a letter.

Answerable.—Obliged to answer ; liable to be called to account ; liable to pay, indemnify, or make good ; accountable ; amenable ; responsible.

Anta.—In building, a species of pier produced by thickening a wall at its termi-

nation, treated architecturally as a *pilaster* with capital and base.

Antecedent.—In mathematics, the first term of a ratio.

Anthracene.—A hydrocarbon found in coal-tar, obtained from that part which distills above 520° F; it is of great commercial value, being the base from which artificial alizarine is prepared.

Anthracite.—Stone-coal; a hard coal containing 90 to 95% of carbon, and very little hydrocarbons, consequently burning without smoke, and with a short flame. It is deep black in color, and lustrous. It is found in Eastern Pennsylvania and South Wales. The different sizes of *screened anthracite coal* may be taken as follows: *egg*, 2½-1¾ ins.; *stove*, 1¾-1¼ ins.; *chestnut*, 1¼-¾ ins.; *pea*, ¾-½ inch; *duckwheat*, ½-¾ inch; *rice*, ¾-½ inch. *Lump and broken coal* are larger sizes than egg.

Anticline.—Properly *anticlinal strata*; the crest of strata originally horizontal, which have been compressed endwise by terrestrial movements, until they have assumed a wavelike form. The trough of the wave is known as the *syncline*, or *synclinal strata*.

Anti-freezing Solution.—A fluid mixture used to fill the hollow parts of machinery when laid off in winter time, especially the water jackets of motors, pump chambers, etc. A satisfactory solution is 10 lbs. *calcium chloride* to a bucketful of boiling water, strained through a cloth before pouring; equal parts of water and *wood alcohol* may also be employed.

Anti-friction Metal.—A term applied to the various tin-lead alloys used to line journal boxes of machinery; as *white metal*, *babbitt metal*, etc.

Anti-friction Rollers.—In machinery, freely revolving or live rollers which sustain the pressure of a revolving spindle or shaft. The crank axle of foot lathes, and the spindles of some running machines are often furnished with bearings consisting of such rollers.

Anti-gugger.—A small tube, inserted into the mouth of a bottle or carboy to admit air while the liquid is running out, and thereby preventing guggling or splashing of corrosive liquid.

Antimony.—A metal, hard, brittle, resembling tin in its fracture, and of a color more resembling tin than lead. Its specific gravity is 6.6, and its melting point 842° F. (Authorities differ widely on this point.) It is used as a hardening ingredient in lead and tin alloys, such as *babbitt* and various other *anti-friction metals*.

Antiquarian.—In drawing and design, a size of drawing paper measuring 52½x30½ inches and weighing 233 pounds to the ream.

Antique Brass.—A special finish given by platers to oxidized brass articles, whereby the portions in relief appear dull and old.

Antiseptic.—An agent which counteracts offensive decay of albuminous or other matter.

Anvil.—A heavy block upon which metal work is hammered by the smith. Those in ordinary use are of wrought iron, weighing one hundred-weight and upwards, faced with about half an inch of hard steel. One side terminates in a *horn* or *beak* upon which circular pieces may be bent, the root of this horn being unfaced so as not to damage the set when cutting bars on the anvil. At the end of the anvil, remote from the beak, is the *hardy-hole* for the reception of the hardy, or *bottom swage*. Special anvils are made of cast iron, with a chilled face.

Anvil Block.—A heavy cast iron or steel block forming the anvil of a steam or power hammer. It is usually faced with a removable steel *pallett* corresponding to the *tip* fitted to the hammer head, the two being varied for different classes of work. The anvil block usually rests on timber and other shock-absorbing foundations.

Apace.—A shop term, meaning fast or a good and rapid rate; said of actions that are being done with dispatch.

Aperture.—1. An opening of any nature in a partition or wall.

2. The orifice in that end of a telescope or other optical instrument, through which the light enters.

Apex.—1. The summit or highest point of a body, or of a geometric figure; as, of a cone or triangle.

2. Geologically, the crowning fold of anticlinal strata; the highest point of a seam or stratum, sometimes confused with an *outcrop*.

Apelion.—In astronomy, that point in the elliptical orbit of a planet which is most remote from the sun; the opposite point, or that nearest to the sun, is termed the *perihelion*.

Apogee.—In navigation, that point in the orbit of the moon which is at the greatest distance from the earth.

Apothecaries Weight.—Apothecaries, in mixing and dispensing medicines, use the *pound*, *ounce* (oz.), and *grain* of this

table of weights ; but divide the ounce into 8 *drams* (dr.), each equal to three *scruples* (sc.), each scruple being equal to 20 *grains*.

SOLID MEASURE.—20 Grains (gr.)=1 scruple (sc.) ; 3 Scruples=1 dram (dr.) ; 8 Drams=1 ounce (oz.) ; 12 Ounces=1 pound (lb).

FLUID MEASURE.—60 minims or drops=1 fluid dram ; 8 Fluid drams=1 fluid ounce ; 16 Fluid ounces=1 pint ; 8 Pints=1 gallon.

Apparatus.—1. Things provided as means to some end, especially a full collection or set of implements, or utensils, for performing scientific experiments or operations.

2. A term specifically applied by railway employees to the contrivance used for exchanging mail pouches while the train is in motion.

Apple-tree Wood.—Timber from the well-known fruit tree. It is heavy, hard and brittle, being chiefly used in turnery ; among millwrights it finds a use for making the inserted teeth of *mortise wheels*.

Appliance.—An instrumental means, aid or device ; as, the *appliances* of a trade, railway *appliances*, etc.

Applied Mechanics.—The principles of mechanics as applied to constructing machinery ; practical mechanics.

Appraise.—To set a value on ; to estimate the worth of, particularly by persons appointed for the purpose ; as, to appraise goods for custom purposes.

Appraiser.—One who appraises, specifically, a person appointed and sworn to estimate and fix the value of goods.

Apprentice.—One who is bound by indentures to serve a mechanic, or other person, for a certain time, with a view to learning the art, mystery, or occupation in which his master agrees to instruct him.

Approximate.—Nearly approaching correctness, not carried out to perfect accuracy ; as, *approximate* results, *approximate* figures.

Appurtenance.—That which belongs to something else, an adjunct or appendage, something annexed to another thing which is larger or more important.

Apron.—Anything resembling in appearance or use the cloth or piece of leather worn for protection in front of the body, as by a blacksmith ; specifically :

1. An endless band of cloth or leather, for conducting loose moving materials, as in a grain conveyor.

2. In paper making, a flap of india-rubber or moleskin which leads the pulp from the strainer gate on to the wire.

3. In a turning lathe, a vertical plate bolted to the front of the saddle or carriage, and forming an integral part of it. The apron supports and guards the gearing for the cross feed, etc., and the nut for the leading screw.

4. A platform at a dock entrance upon which the gates close.

5. The masonry platform which receives the water that falls over a dam or weir or through a sluice.

6. A facing or revetment of logs, rubble or rip-rap, to serve as protection to an embankment or the banks of a water-way.

7. A carpenter's term for a flat lining or covering protecting parts underneath ; as, the inside woodwork under a window.

8. A plumber's term for a *flashing* or strip of metal leading a drip of rain water into a gutter or eaves-trough, also the flashing of a dormer window.

Apron Conveyor.—A type of grain, ore or coal conveyor, which consists of a plain traveling belt composed of link sections, for transport horizontally or on a gentle gradient.

Apron Joint.—A method of connecting endless belts by means of a butted joint, covered with a piece of the same material known as an apron. If the apron is made of a good length and tapered gradually away to a thin edge, it provides the most efficient fastening known.

Apse.—In architecture, a projecting part of a building, especially of a church, having in the plan a polygonal or semi-circular termination, and often projecting from the east end.

Aqua Ammonia.—Ammonia in the form of a liquid, mixed with water.

Aqua fortis.—A shop name for commercial *nitric acid*, consisting of 70 per cent. acid and 30 per cent. water. So called by the old alchemists (*strong water*), on account of its property of acting on metals.

Aqua Reg'ia.—*Royal water*, a mixture of two parts nitric acid with four parts of hydrochloric acid, so called by the alchemists as it dissolves gold, "the king of metals."

Aquathruster.—A variety of *pulsometer*, in which the steam presses directly upon

the surface of the liquid which it forces from the pump, the condensation of the steam occasioning a sufficient vacuum to fill the chamber afresh for the next pulsation.

Aquatint.—A method of engraving on copper assisted by a resinous protecting solution and nitric acid. The process differs from *etching*, in that the spaces are bitten in and not the lines, thus permitting the reproduction of broad effects such as those of india-ink or sepia work drawings.

Aqueduct.—In civil engineering, a conductor, conduit or artificial channel for conveying water, especially one for supplying cities with water.

Aqueous Rocks.—Those rocks, sedimentary in structure, which have been formed directly by the action of water, as distinguished from those formed by the action of ice and glaciers, by wind blown deposits, or by volcanic agencies.

Aqueous Vapor.—The invisible vapor of water produced by evaporation from the earth's surface and rising into the atmosphere, whence it falls as *dew*, *rain*, *hail* or *snow*.

Arabesque.—Anything carved or painted forming a decoration after the Arabic manner; originally designating the purely geometric ornamentation of Mohammedan architecture.

Arabic Numbers.—The characters employed to denote arithmetical figures are so termed, as they were introduced into Europe by the Arabs or Moors during their occupation of Spain. They were, however, of still earlier origin, probably having been invented in Hindostan.

Arbitrary.—1. Chosen or designated at will; selected as a result of choice rather than as the workings of a fixed rule.

2. Independent of rule or control, or of governing commands.

Arbor.—1. A mandrel as used in turning pieces already bored.

2. An axle or spindle of a wheel, especially in watch or clock making.

Arbor Press.—An appliance used for forcing arbors or mandrels into or out of work by the aid of a hydraulic or of a screw-press. This prevents straining the work or hammering up the ends of the arbors, besides

saving time. It consists essentially of a bolster upon which the work holding the mandrel is laid—a ram, with a copper or white metal nose-piece, brought down on the end of the arbor, forcing it in or out.

Arcade.—1. A vaulted passage-way or street; in some cities a roofed passage-way having shops, etc., opening from it.

2. In architecture, a series or range of arches with their supporting pillars, columns or piers standing free, as an ornament or as a support for a roof or the like.

Arch.—1. A brickwork or masonry structure, built to a curved outline, with wedge-shaped pieces, which mutually support each other and the whole supported at either end. The base of the semi-circle or semi-ellipse is the *springing-line*; its length the *span*; the summit of the curve is the *crown*; its vertical height above the springing-line the *rise*; the inner curve is the *intrados*; the outer curve is the *extrados*; the wedge-shaped pieces are *voussoirs*; the crowning one which locks them, the *key-stone*; the lowest from which they rise, the *springers*. A half of an arch is a *haunch* or *flank*. The supports have various names; *bearing walls*, if simple vertical walls; *abutments*, if they resist an oblique thrust; *piers*, if they are simple vertical columns or shafts. A *skew-arch* is one that crosses a road or river at an angle.

2. A structure of arch-like appearance and use, having its curved outlines and calculated to bear the same stresses; as, in a concrete or iron bridge.

3. The curved hanging wall of brickwork in a locomotive fire-box, suspended by special water tubes, or supported at the sides by bolts in the fire-box shell.

Arch-board.—In ship-building, a plank sprung across a vessel's stern, bearing (usually) the name and sometimes the register.

Arch-brick.—A shaped fire-brick to fit into the arch of a locomotive fire-box.

Arched-beam.—A beam, cut, bent or built into an arched form, to support a structure, as a ceiling, roof or viaduct.

Arch gauge.—An instrument for measuring the pressure of illuminating gas, where the *index scale* is in the form of an arch.

Archimedeal Drill.—A hand drill for light work, whose stock is formed into a multiple spiral of quick pitch over which a nut or spool slides easily. The act of sliding the nut up and down the stock makes the latter and consequently the drill, rotate first one way and then the other, pressure being applied by a knob or ball at the opposite end of the stock.

Archimedeal Screw.—In hydraulics, the invention of Archimedes when in Egypt about 260 B. C. It consists of a

hollow inclined screw, or a spiral pipe, around an inclined axis; the lower end is submerged in the water and the upper end discharges.

Archimedes.—A famous mathematician and inventor of ancient times. Born in Syracuse, Sicily, B. C. 287. After much time spent in travel, he returned to his native city and there devoted himself to developing a remarkable series of inventions, among the best known of which were the endless screw for launching ships; the hydraulic screw used to drain the fields along the Nile after the annual overflow; and the military catapult invented to repel a siege of the Romans. He first established the fact that a body immersed in a liquid loses as much weight as that of the volume of the liquid displaced.

Archipelago.—Any sea or broad sheet of water interspersed with many islands or with a group of islands; the island group itself.

Architect.—A professional man skilled in the art of designing and constructing useful and suitable buildings. An architect plans, specifies and superintends, a builder erects. The art of architecture is divided into various categories, as: *civil*, including most works of ordinary utility; *ecclesiastical*, pertaining to churches, cathedrals, etc.; *military*, dealing with fortifications. The science of ship designing is usually termed *naval architecture*.

Architecture.—Classical architecture is divided into *orders*; an order of architecture is a composition consisting of a column, its pedestal, and the entablature which it supports; certain modifications omit the pedestal. The three Grecian orders are *Doric*, *Ionic* and *Corinthian*, whose ornateness increases in the order given. The Romans modified and employed these orders, introducing two of their own, *Tuscan* and *Composite*. Architecture since classical times has been divided into *styles*, each style of architecture bearing the name of the region where or the chronological period in which it flourished, as *Byzantine*, *Norman*, *Italian*, *Gothic*, *Renaissance*, *Elizabethan*, etc.

Architrave.—1. In architecture, the lower division of an entablature, or that part which rests immediately on the column, especially in classic architecture.

2. In carpentry, the group of moldings or other architectural member above and on both sides of a door or other opening, especially if square in form.

Archives.—A place of deposit for papers and documents of interest or importance. By extension, the documents so deposited.

Arch-stone.—A wedge-shaped stone used in an arch; a *vousoir*; keystone. In some furnaces, the chamber, or an opening thereinto, is covered by a flat ashlar, which is called an *arch-stone*.

Arc of a Circle.—Any portion of the circumference; the curved boundary of a segment, or that part of the circumference cut off by any angle.

Arc of Contact.—1. That portion of the circumference of a pulley, etc., which is in contact with the belt or rope. Thus, with two pulleys of uniform size, the belt will touch half the circumference of each, and the arc of contact for each pulley will be 180° .

2. In gearing, that part of the pitch-line, through which two engaging teeth pass while in contact.

Arctic Circle.—The imaginary circle, $23^{\circ} 27'$ from the North Pole, that separates the north temperate zone from the north frigid zone.

Area.—1. The surface included within a given boundary; superficial extent; as, the area of a square or other geometrical figure.

2. A walled excavated space in front of a house having a basement, to afford access or admit light to that floor of the building. Frequently under the name *dry area*, of which the ordinary term is a contraction, this walled space is carried all round the basement, preventing the damp soil from coming into contact with the walls. This side space is covered over, except where openings are required for ventilation and light.

Areometer.—An instrument for measuring the specific gravity of liquids. It is practically the same as the *hydrometer*, the only difference, if any, being that the areometer has the thermometer within its own stem, thus permitting temperature and gravity to be read from one instrument.

Argand Burner.—A lamp having a tubular wick contained between two concentric metal tubes, and a central air supply; a gas-burner of similar pattern in which the gas is supplied to the flame through the ring between the concentric tubes.

Argentiferous.—Producing or containing silver; as, argentiferous lead ore or veins.

Argil.—Potters' clay—from the Latin—argilla; *white clay*.

Argillaceous.—Of the nature of clay; consisting of, or containing *argil* or clay.

Argon.—A colorless gas much resembling nitrogen, which was discovered as a constituent of the atmosphere by Lord Rayleigh and Professor Ramsay in 1894. It is present in ordinary air to the extent of 0.9 per cent., and is the most inert substance known, as, up to the

present, it has refused to combine with any other substance. Other recently discovered constituents of atmospheric air are "krypton" ($=0.01\%$), "helium," "neon" and "metargon," but comparatively little is known respecting these.

Arithmetic.—The orderly arrangement of numbers and their application to the purposes of life.

Arithmetical Formula.—In arithmetic, a general rule expressed by signs.

Arithmetical Signs.—The characters or marks used in arithmetic to denote the operations. Thus :

= *Equal to.* The sign of equality; as $100 \text{ cts.} = \$1$, that is, one hundred cents are equal to one dollar.

— *Minus or less.* The sign of subtraction; as $8 - 2 = 6$, that is, 8 less 2, is equal to 6.

+ *Plus or More.* The sign of addition; as $6 + 8 = 14$; that is, 6 added to 8, is equal to 14.

× *Multiplied by.* The sign of multiplication; as $7 \times 7 = 49$; that is, 7 multiplied by 7 is equal to 49.

÷ *Divided by.* The sign of division; as $16 \div 4 = 4$; that is, 16 divided by 4 is equal to 4.

Ark.—In navigation, a flat bottom boat made of a frame and boards which do not usually overlap, but are nailed to the frame and have the interstices caulked or daubed.

Arkwright, Sir Richard.—Born 1732, died 1792. An English inventor celebrated for the invention of cotton-spinning machinery, laying the foundation for the world's great cotton industry. He took out his first patent in 1767 and two years later built his first mill; he increased his plant in 1771 driving his own improved machinery by steam-power resulting in great efficiency. He had considerable misfortune in connection with his patents but after much litigation finally triumphed.

Arm.—1. In structural steel, one of the wings or flanges of angle-iron. The side arm of the angle-iron in a ship's frame forms the *faying* surface to which the plates are riveted.

2. One of the members or projections of a knee. With timber knees, the arms are usually two, resting against the beam and the ship's side. With iron knees the arms may be more numerous, and may embrace other sides of the object to which they appertain.

3. The outer piece of an overshot waterwheel bucket. Also called the *wrist*; the inner piece is the *floor* or *bottom*.

4. In machinery, the handle of a trip hammer, which receives the impulse of the cams.

5. In mill construction, the beam of a wind-mill which receives the impulse of the cams.

6. In navigation, the end of a *yard*.

Arming.—In navigation, tallow placed in the cup at the bottom of a sounding-lead to bring up samples of the sea-bottom and assist in locating the vessel's position.

Armored Concrete.—Concrete which is *reinforced* or strengthened by the incorporation of suitably disposed steel bars and rods; the reinforcement being arranged to utilize the superior tensile strength of the metal, while the compressive stresses are designed to be borne by the concrete itself.

Armored Hose.—In hydraulics, hosepipe strengthened externally by a protection of spirally coiled wire.

Armored Pump Valves.—India-rubber valves moulded upon an internal disc of sheet-steel. The disc is stamped with notches and projections, and copper-plated to secure the adhesion of the rubber, which is vulcanized after moulding.

Armored Wood.—In erecting, structural timber parts reinforced by steel or iron plates and sections, as with fitch beams, etc.

Armor Plate.—Thick plating disposed as a cuirass around the vital parts of a warship to protect her armament and personnel from gun fire.

Armory.—1. In mechanics, a plant for making arms; an establishment for the manufacture of arms; as, the U. S. Armory at Springfield, Mass.

2. A building for the safe keeping of arms.

Armstrong, Sir Wm. G.—Born at Newcastle-on-Tyne, Nov. 26, 1810, son of William Armstrong, a merchant. He was sent to school first at Whickam, thence to the grammar school. His first work was in the office of Mr. Armorer Donkin, a solicitor. There he completed his legal education with exception of a year he spent in London, reading law. Eventually he became junior partner in the firm of Donkin, Stable & Armstrong, and for about fifteen years practiced assiduously as a solicitor, not neglecting however, during this time, to employ his leisure in following his natural bent for science. He invented a *hydro-electric* machine for the production of high-tension electricity which made him famous, also leading to his being elected fellow of the Royal Society, in 1843, being proposed by Faraday. His hydraulic inventions including a crane and accumulator, met with much success. In 1854 he invented a gun with which his name is popularly associated. He was soon afterwards knighted. In 1882 the firm of W. G. Armstrong & Co., was founded, their works being the largest in the world. Lord Armstrong has been granted hon. degree of L. L. D. from Cambridge; D. C. L. from Oxford, and Master of Engineers from Dublin. He received also many other distinctions.

Around.—1. In a circle; circularly; on every side; round.

2. In a circuit; here and there within the surrounding space; all about; as, to travel *around* from town to town.

3. Near; in the neighborhood; as, this man was standing *around* when the disturbance took place.

Arrange.—1. To put in proper order; to dispose in the manner intended, or best suited for the purpose.

2. To adjust or settle; to prepare; to determine; as, to *arrange* the preliminaries of contract.

Arrastra.—A Mexican contrivance, consisting of a stone-paved pit, about 12 feet in diameter, within which heavy stones are rolled or dragged over ores to reduce them; the crushing stones are drawn by arms radiating from a central post, which is rotated by animal power.

Arrearage.—That which remains unpaid and overdue, after previous payment of a part; arrears.

Arrest.—1. To stop; to check or hinder the motion or action of; as, to *arrest* the current of a river.

2. To seize on and fix; to hold; to catch; as, to *arrest* the eyes or attention.

Arris.—1. A sharp edge or corner, as of a square block; the meeting of two surfaces, which produces an angle.

2. The sharp edge raised upon the corners of metal pieces by the process of machining their surfaces, which has to be removed by file or scraper.

Arris-gutter.—In carpentry, a V-gutter fixed to the dripping eaves of a building, and so attached as to have pitch enough for the water to run off to the leader.

Arrol, Sir William.—Born in the village of Houston, Renfrewshire, 1839. He received little schooling and at the age of nine began work in a cotton-mill. He found employment in various districts in England and Scotland before becoming a foreman in the boiler and bridge yard of R. Laidlaw & Sons, Glasgow. When twenty-nine years old he began business for himself in Glasgow making boilers, girders and general structural work. In 1871, was founded the firm of Sir William Arrol & Co., Limited. An important undertaking and one which was destined to make his reputation, was the construction of the great Forth Bridge. Sir William Arrol & Co. undertook the erection of the main viaducts for the Manchester Ship Canal Co. They also furnished the steel work for the Tower Bridge across the Thames in London.

Arrow-heads.—In mechanical drawing, these are usually made with a writing pen; they limit distances, etc., to which particular attention is desired to be drawn.

Arroyo.—A name derived from the Spanish, meaning a rivulet, small stream, or water course for irrigation purposes.

Arsenal.—A government establishment either for the storage, the manufacture or both combined, of weapons and munitions of war.

Arsenic.—A dark gray element, not a true metal, but resembling one. It is brittle and crystalline, easily pulverized, has a specific gravity of 5.7, begins to volatilize at 212° F. sublimates at 336° into lemon-tinted vapor, but melts only under pressure at about 980° F. Native arsenic is found in many places; it is also found in compounds as *orpiment*, *realgar*, etc. Metallic arsenic is alloyed with lead in making shot for fowling-pieces; various compounds are used in *medicine*, some in *dyeing*, etc. The green pigments, known as *Scheele's* and *emerald-green*, are of arsenical origin, and as such are prohibited in certain countries, especially on wall-papers, where the arsenical dust may brush off.

Art.—The systematic application of knowledge or skill in effecting a desired result. Also, an occupation or business requiring such knowledge or skill.

Artesian Well.—A bored well of comparatively small diameter and great depth, from which the water rises to the surface and overflows by reason of hydrostatic pressure, corresponding to the super-elevation of that district whence the subterranean water course originates. Such wells derive their name from the French province of *Artois*, where they were first bored. Any bored well of great depth is now termed *artesian* whether it fountains or has to be pumped.

Artifice.—1. A handicraft; a trade; art of making

2. Workmanship; a skillfully contrived work.

Artificer.—1. A skillful handicraftsman; one who makes or produces by exercising art or skill in an industrial pursuit.

2. A working or operative engineer carried on board warships, mail steamers and the like, to assist the engineer, officers who keep watch and are responsible, the manual labor and much routine falling on the artificers; in the U. S. Navy, these are designated *machinists*.

Artificial.—Having been made, constructed or compounded by the *art of man* as distinguished from similar objects or substances originating in the processes of *nature*.

Artificial Ice.—Water frozen artificially, either by reduction of the surrounding temperature, or more generally by exposing the moulds in which, for convenience it is frozen, to the action of refrigerated brine, circulated around or through them.

Artificial Seasoning.—Timber is seasoned artificially by exposing it in a suitable chamber to a current of hot air, delivered either from a fan, or by a natural draught. Small blocks can be roughly and quickly seasoned by boiling them in water for two or three hours and then allowing them to dry.

Artificial Stone.—A mass resembling concrete, but saturated with an impervious material, which is moulded into paving-slabs, steps, balustrades and such trimming or finishing pieces as lintels, quoins, window-sills, door steps, etc. One variety is composed of the refuse of granite quarries, broken to size and mixed with 25 per cent. of Portland cement, the whole being mixed with water to form a dough-like consistency, when it is run into suitable moulds; after setting, the blocks are saturated by immersion in a solution of silicate of soda. Another kind consists of clean and dry sand, gravel, etc., mixed in a mill with silicate of soda, the pasty mass being pressed into suitable moulds; when sufficiently set, the blocks are immersed in a solution of calcium chloride, saturation being assisted by an air pump or by pressure. The chemical reactions form calcium carbonate which indissolubly binds the siliceous materials together, the sodium chloride being washed out afterwards with plenty of water, as it would tend to form a white efflorescence on the stone if permitted to remain.

Artillery.—The men and officers of that branch of the army to which the care and management of cannons, great guns, etc., are confided.

Artisan.—One trained to manual dexterity in some mechanical art or trade; a handicraftsman; a mechanic.

Asbestos.—A fibrous variety of ferromagnesium silicate, the fibers being usually so fine as to be flexible and easily separated by the finger. It is found in Italy, Canada, Cape Colony, United States and elsewhere. Asbestos is extremely incombustible and its fibrous nature permits it to be spun into yarn, which may be plaited to form piston-rod packings, etc., or to form the basis of fire-proof cloth, millboard and paper. When ground into powder it is easily made into a cement which serves as a non-conductor of heat. Asbestos-made materials are liable to decay or perish where in contact with water, but resist oil (hot or cold), gases, steam, etc.

Ascend.—1. To move upward; to mount; to go up; to rise.

2. To rise; in a figurative sense, to proceed from an inferior to a superior degree.

Ash.—1. A tree of the olive family. It is tough, flexible, fairly hard, with a close well-marked grain, and of a light color; the American wood is closer grained and of a much lighter color than the European. Ash wood is employed wherever toughness and flexibility are essential, as in handles for hammers, picks and other tools, shafts for vehicles, wheels, barrel hoops, etc.

2. The incombustible mineral residue remaining after anything has been burned.

Ash-bucket.—A receptacle for transporting ashes, etc., by means of a hoist.

Ash-ejector.—An apparatus fixed in the stokehole of a steamer, whereby the ashes are blown into the sea by means of a jet of water or compressed air.

Ashes.—A general term for the unburnt matter remaining after the combustion of any fuel, it comprises incombustible mineral constituents, dirt admixed with the fuel, and some unconsumed fuel. The nature of the ashes depends upon that of the fuel and the method of combustion.

Ash-hoist.—In navigation, a small engine for hoisting ashes on deck to dispose of them overboard.

Ashlar.—1. In carpentry, a vertical strut or quatering uniting the floor joisting of the garret with the rafters above, forming the studding for the wall of the half story room, cutting off an acute angle which may be utilized for closets.

2. In masonry, a facing of squared stones or thin slabs used to cover walls of brick or rubble.

Ash-pan.—A receptacle, placed beneath the firebox of a locomotive, to catch ashes and cinders which fall through the grate.

Ash-pit.—The space beneath the fire-bars in a furnace. As normally made it constitutes a *dry ash-pit*; when a trough is placed below the bars to cool them by evaporation of a sheet of water, it is said to be a *wet ash-pit*.

Ash-shoot.—An inclined or nearly vertical trough to send ashes, etc., down from the deck overboard; also written chute.

Aspen.—A species of poplar, whose leaves are always quivering on account of the way they grow from the stem or twigs. The wood is very light and soft, of a white color tinged with brown; chiefly used in the manufacture of *wood-pulp*.

Asphalt.—This name is given to three diverse, allied substances. (1). The base or ultimate results of changes in those petroleums or natural hydro-carbons which do not contain paraffin; (2), natural deposits of bitumen, originally derived from petroleums, which are found in the form of self renewing lakes in Trinidad, (W. I.), Venezuela, and elsewhere, (3), limestone rock impregnated with 8 to 20 per cent. of bitumen, is found in the Val de Travers, in Switzerland. The derivative from petroleum is often termed *mineral pitch*, and serves as a waterproof paint, an anti-corrosive covering, etc. *Trinidad asphalt* is mixed, while hot, with sand or fine gravel for the purpose of lining tanks, paving streets, forming damp-courses or roofing, in buildings, etc.; they are also used to impregnate paper or textile fabrics for similar purposes. The *French and Swiss asphalts*, so largely used in London and Paris, require no admixture, as they crumble to pieces under heat, in which condition they are spread and rolled, regaining the appearance of the original rock on cooling.

Aspirator.—A device closely resembling an ejector, in which water passes through a nozzle, whose outlines conform to the *vena contracta*. This device induces a suction current in a connecting pipe and exhausts the air thus creating a high vacuum. The *steam ejector* used in connection with the vacuum brake, is also a type of aspirator.

Assay.—In metallurgy, the act or process of ascertaining the proportions of a particular metal in an ore or alloy; especially the determination of the proportion of gold or silver in bullion or coin.

Assemble.—To collect into one place or body; to bring or call together; to convene.

Assembling.—The bringing together the parts of a machine or device. The combination of the various pieces forming a small intricate article, such as a rifle or typewriter, is properly known as *assembling*; the word *erecting* conveying the idea of building a large machine or structure with stagings, blocks-and-tackles, etc.

Assets.—The entire property of all sorts belonging to a person, a corporation, an estate or a trades union; as, the *assets* of a manufacturer or labor union.

Assign.—1. To appoint; to allot; to apportion; to make over.
2. To fix, specify, or designate; to point out authoritatively or exactly; as, to *assign* a limit.

Assignee.—A person to whom an assignment is made; a person appointed or deputed by another to do some act, perform some business, or enjoy some right, privilege, or property.

Assignment.—An allotting or appointment to a particular person or use, or for a particular time; as, of a cause or causes in *Court*.

Assist.—To give support in some undertaking or effort, or in time of distress; to help; to aid; to succor.

Assistance.—The act of assisting; help; aid; furtherance; succor; support.

Associate.—1. To join with one, as a partner or confederate; as, to *associate* others with us in business, or in an enterprise.

2. To join or connect; to combine in acting; as particles of gold *associate* with other substances.

3. To connect or place together in thought.

Association.—Union of persons in a company or society for some particular purpose; as, the *American Federation of Labor*.

Assort.—1. To separate and distribute into classes, as things of a like kind, nature or quality, or which are suited to a like purpose; to classify; as, to *assort* goods.

2. To furnish with or make up, from various sorts or varieties of goods; as, to *assort* a cargo.

Assortment.—1. A collection or quantity of things distributed into kinds or *sorts*; a number of things assorted.

2. A collection containing a variety of sorts or kinds adapted to various wants, demands or purposes.

Assume.—1. To take to or upon one's self; to take formally and demonstratively; sometimes to appropriate or take unjustly.

2. To take for granted, or without proof; to suppose as a fact.

Assure.—1. To make sure or certain; to render confident by a promise, declaration, or other evidence.

2. To confirm; to assert; to vouch; to convince.

Astatki.—The residue of petroleum, after the distillation of the illuminating oils; used as fuel on steamers, etc.

Astern.—Behind a ship; opposite to *ahead*.

Asteroids.—In navigation, a star-like body; especially one of the numerous small planets whose orbits lie between those of Mars and Jupiter; called also *planetoids* and minor planets.

Astrolabe.—An instrument with a graduated circle or circles, formerly used for measuring the altitudes of the heavenly bodies, or for observing angles in surveying. It was made in various forms, but has been superseded by the *sextant*, *theodolite*, etc.

Astronomy.—The science of the stars; that science which deals with the position, motion, and nature of the various heavenly bodies.

Athwart.—1. Across; from side to side; transversely.

2. Across the course; as, athwart the bow of the ship.

Atlas.—1. A size of drawing paper measuring 33 x 26 inches and weighing 100 pounds to the ream.

2. The Indian satin of commerce.

3. In architecture, male human figures serving as pillars; called also *telamones*; female figures employed for the like purpose are termed *caryatides*.

Atmosphere.—1. The air in which we live and which we breathe; whose weight presses on our bodies internally and externally and so is not perceived; whose motions cause the gentle breeze and the mighty hurricane. It lies like a thick blanket around the earth, rendering it habitable; preventing the evaporation of its seas; maintaining the circulation of life-sustaining water from the sea to the land and back; modifying the intense heat of the direct sun rays and the intense cold of space, to which our planet would otherwise be subjected by the alternations of day and night. Besides, the oxygen, nitrogen, argon, etc. (see *air*) there is present in the atmosphere about 0.04 per cent. by volume, of carbon dioxide, a variable amount of aqueous vapor, ammonia in various forms, and solid matter or dust.

2. The pressure of the atmosphere at the sea-level is about 14.7 pounds per square inch; for a rough approximation it may be assumed that the pressure decreases $\frac{1}{4}$ pound per square inch for every 1000 ft. of ascent.

Atmospheric Condenser.—1. An air-cooled surface condenser, as in steam automobiles.

2. As understood by refrigerating engineers, an *evaporative condenser*, cooled by water spray and natural air currents.

Atmospheric Engine.—An early form of steam engine, in which the upper end of the vertical cylinder was exposed to

the atmosphere. The piston was forced to the upper limit of its stroke by a slight steam pressure beneath it, but chiefly by counterweights on the beam; upon condensing the steam in the cylinder, a partial vacuum was formed, and the external air pressed the piston down, thus operating the engine. It is interesting to note that some early gas engines used atmospheric pressure for the downward stroke of the piston.

Atmospheric Line.—The horizontal line on an indicator diagram representing the position of an indicator piston when there is neither steam pressure nor vacuum in the indicator cylinder.

Atmospheric Pressure.—In steam engineering, the weight of the atmosphere pressing upon the exhausting side of a steam engine piston; this weight, or pressure can be partially removed with the aid of a condenser.

Atoll.—An annular group of coral reefs or small islands surrounding a central lagoon, no part being more than a slight elevation above the surrounding sea. The inner slope is gentle but the seaward angle of the reef is very steep and abrupt, the atoll seeming to lie as a crown upon the crest of a submarine mountain.

Atom.—The chemical unit, imagined as an extremely minute particle of matter constituting the smallest quantity of an element, which is capable of existing, and therefore deemed indivisible. Three elements, *mercury*, *zinc* and *cadmium* can exist as atoms; the atom of the remaining elements combines with others of the same or different substances to form the *molecule*, or physical unit.

Atomic Theory.—The accepted theory of the constitution of matter which asserts that all substances are composed of infinitesimally small particles or atoms. The atom of each elemental substance possesses properties peculiar to itself which govern the manner in which the element enters into combination with others to form a molecule.

Atomic Weight.—A relative weight assigned to the atoms of the various elements, representing, (1) its weight as compared with that of an atom of hydrogen; (2) the smallest quantity by weight of the element that can enter or leave a compound, the combining quantity of hydrogen equalling unity; (3) the specific gravity of the body, as compared with hydrogen, when in a state of gas or vapor.

Atomize.—To separate a jet of any liquid into a finely subdivided spray, resembling liquid dust; effected either by hydrostatic pressure or by a blast of compressed air or steam in conjunction with specially shaped nozzles.

Atomizer.—Any device whereby a liquid is reduced to minute particles, or to a mist or spray.

Atomizing Carburettor.—A type of carburettor for internal combustion engines, in which the liquid fuel is converted into a fine spray and mixed with the proper proportion of atmospheric air. Known also as *spray carburettor*.

Atomizing Nozzle.—The spraying nozzle attached to the atomizing or spray carburettor of a gasoline motor.

Atrium.—1. In architecture, a square hall lighted from above, into which rooms open at one or more levels.

2. An open court with a porch or gallery around three or more sides

Attach.—1. To tie, bind, fasten, or connect; to make fast or join; as, to *attach* one thing to another by a rope, glue or the like.

2. In architecture, an *attached* column is a column engaged in a wall, so that only a part of its circumference projects from it.

Attachment.—1. That by which one thing is attached to another; connection.

2. Something attached, some adjunct attached to an instrument, machine or other object; as, a sewing machine *attachment*—a device attached to do a special work, as tucking, etc.

Attain.—1. To achieve or accomplish, that is, to reach by efforts; to gain; to compass.

2. To reach or come to, by progressing or motion; to arrive at; as, the engine attained its speed.

3. To reach in excellence or degree; to equal.

Attemperator.—A coil of pipe, sometimes working on a swivel or hinge, and through which refrigerated brine or other liquor is passed. Used to cool vessels containing warm liquids such as fermenting vats.

Attempt.—An essay, trial, or endeavor; an undertaking; an attack, or an effort to gain a point; especially, an *unsuccessful*, as contrasted with a successful, effort.

Attend.—To care for; to look after; to take charge of; to watch over; as, the engineer *attends* to his engine.

Attendant.—One who is present and takes part in the proceedings; as, an *attendant* at a meeting.

Attention.—The act or state of attention or heeding; the application of the mind to any object of sense, representation, or thought; notice; exclusive or special consideration.

Attenuate.—1. To make thin or slender; as, by mechanical or chemical action upon inanimate objects, or by the effects of starvation, diseases, etc., upon living bodies.

2. To lessen the amount, force or value of; to make less complete; to weaken.

Attic.—In building, a low story above the main order of a facade; all the rooms immediately *below the roof*

Attle.—In mining, rubbish or refuse consisting of broken rock containing little or no ore.

Attorney.—A substitute; a proxy; an agent. An attorney is either *public* or *private*. A private attorney or an attorney in fact, is a person appointed by another, by a letter or power of attorney, to transact any business for him out of court; but in a more extended sense, this word includes any agent employed in any business, or to do any act in place of another. A public attorney or *attorney-at-law*, is a practitioner in a court of law, legally qualified to prosecute and defend actions in such courts.

Attraction.—An invisible power in a body by which it draws any thing to itself; the power in nature acting mutually between bodies or ultimate particles, tending to draw them together, or to produce their cohesion or combination, and conversely resisting separation. *Attraction* is exerted at both *sensible* and *insensible* distances, and is variously denominated according to its qualities or phenomena.

Attractive.—1. That which attracts or draws, an attraction; as, an *attractive* exhibit of machinery.

2. Having the power or quality of attracting or drawing; as, the *attractive* force of bodies.

Attrition Mill.—A type of grinding mill for maize, oil-cake and other feed stuffs, which disintegrates the material by rubbing between revolving circular plates of hardened steel, which are provided with radial projections or studs ground to a sharp edge or point.

Auction.—A public sale of property or merchandise to the highest bidder, especially by a person licensed and authorized for the purpose; a *vendue*.

Audit.—1. An examination in general. An examination of an account or of accounts with the hearing of the parties concerned by proper officers, or persons appointed for that purpose, who compare the charges with the vouchers, examine witnesses, and state the result.

2. A statement of accounts; a balance-sheet.

Auditor.—A person appointed and authorized to audit or examine an account or accounts, compare the charges with the vouchers, allow or reject charges, and state the balance.

Auger.—A carpenter's instrument for boring holes, chiefly in wood. It consists of a long shank or axis having a cutting edge at one end, and usually a handle placed crosswise at the other, by which it is turned with both hands. A *shell* or *pod-auger* is one with a straight channel or groove, like the half of a bean pod. A *screw-auger* has a twisted blade, by the spiral groove of which the chips are discharged.

Auger-bit.—A small auger to be used as a *bit* with a swing-brace.

Auger stem.—In well boring, the heavy bar to which the drill bit is attached.

Auget.—1. A small trough to drain the passage leading to an explosive mine, thus keeping the saucisson or train dry.
2. A damp-proof tube or trough leading to the explosive in blasting.

Auriferous.—Bearing or containing gold; from the Latin word *aurum*, gold.

Austral.—In navigation, southern; lying or being in the south; as, austral land; austral ocean.

Authorize.—1. To clothe with authority, warrant, or legal power, to give right to act; to empower; as, to *authorize* commissioners to settle a boundary.

2. To sanction or confirm by the authority of some one; to warrant; as, to *authorize* a report.

3. To justify; to furnish a ground for.

Autogenous Soldering.—The art or process of *lead burning*, whereby two pieces of lead are fused together by means of a *hydrogen flame*.

Auto Igniter.—A small magneto-generator or dynamo for electric ignition of gasoline and petroleum engines, the armature of which is geared to the fly-wheel, thus supplying electricity as long as the engine revolves, and doing away with batteries, etc.

Automatic.—Self-acting; especially applied to machinery in which certain movements, commonly made by hand or by an attachment, are made by the machine itself.

Automatic Action.—In hydraulics, a term applied to the device connecting pumping engines or independent feed pumps with the accumulator or a float in the feed tank, so that the pump stops or starts, goes fast or slow without attention, depending upon the amount of work to be done.

Automatic Brake.—In a railway, a continuous brake that acts automatically on rupture of the air-hose, caused by the train breaking apart.

Automatic Carburettor.—A carburettor or vaporizer for a gasoline engine, which performs all its functions automatically.

Automatic Couplings.—In railroads, that type of couplings which interlocks and grips by the action of two vehicles coming together, thus obviating the necessity of persons going between the cars to couple up.

Automatic Engine.—A term applied to a steam engine, in which the cut-off is varied according to the load, by means of the governor.

Automatic Expansion.—An arrangement of the valve gear of a steam engine, the cut off being varied by the action of the governor according to the load. This principle is seen in the Corliss type of engines, but the term automatic expansion, applies more particularly to *high speed* engines.

Automatic Flushing.—A device whereby liquid sewage is accumulated in a chamber until the latter is full, when a syphon action takes place, and the liquid rushes through the sewers, effectually flushing them. Also applied to a similar arrangement within a flushing cistern at public conveniences, an intermittent and effective flushing being attained at regular intervals by the syphon action.

Automatic Gear Cutter.—In machine shop practice, a development of the universal milling machine, specially designed for the production of toothed wheels. The machine is automatic in its action, that is, after the operator has fixed the work and adjusted the cut, the blank is rotated by the machine, thus presenting a fresh tooth to the milling cutter at each pass.

Automatic Governor.—In a steam engine, a type of centrifugal governor which alters the travel of the valve by aid of suitable mechanism, thus securing variable expansion.

Automatic Ignition.—Ignition of the charge, within an internal combustion engine, by the heat of compression. The same may be said of similar engines, in which the forcing of the charge into a heated retort procures the explosion, without an ignition device.

Automatic Inlet Valve.—An admission valve, for internal combustion engines, which is operated by the suction of the piston instead of a mechanical valve gearing.

Automatic Lubrication.—A term applied to devices whereby the motion of a mechanism actuates a regulable supply of lubricant for various wearing parts; as in *sight feed*, *worsted*, *chain oiling*, etc.

Automatic Machine.—A machine tool, whose parts and whose various movements are so co-ordinated with each other that it requires no further attention, after first setting or adjusting the various parts, than to supply it with material, lubricate it, or apply or shut off the power. The hollow spindle lathe, with stops, capstan rest, wire feed, etc., is a good example of this type. Where an attendant or operator is necessary, the machines are made *semi-automatic*.

Automaton.—A machine whose motive power is concealed within itself, or as the term is more generally understood, a machine which imitates the actions of men or animals, and being moved by clock work or other similar instrumentality, appears to perform certain acts by its own volition.

Automobile.—The same as *motor-car*. A self-propelled vehicle designed to run upon ordinary roads, transporting passengers and commodities beyond those necessary for its own consumption and guidance. The classification of motor carriages is usually by their bodies, the customary terms of the coach builders being frequently employed. A *runabout*, is a small vehicle accommodating generally two persons; a *touring car* is a larger vehicle, seating four or more, with fittings for extended trips; a *limousine* has the rear seats enclosed within a carriage body, the driving seat being protected by a canopy, a *tourneau* is a rounded barrel-shaped accommodation, frequently with a rear entrance.

Auxiliary.—1. Giving or furnishing aid or support, especially in a supplementary manner; accessory.

2. In mathematics, a quantity introduced for the purpose of simplifying or facilitating some operation, as in equations.

Auxiliary Engines.—In navigation, steam engines fitted on shipboard for other purposes than the propulsion of the vessel. They include feed and circulating pumps, also occasionally air pumps, all of which run with the main engines; bilge, sanitary, and fire pumps; refrigerators, distillers, blowing fans; electric light machinery; hydraulic pumps and accumulators for cargo working; steam winches, windlasses, capstans; steam steering gear. A small size mail steamer may easily have twenty-four small engines in her engine room, a large warship will have sixty to seventy on board.

Avenue.—As the word implies, is properly an approach to a mansion, public building, etc.; the general application of the word signifies a driveway or road, approximately straight, and flanked by rows of trees on either hand. In many cities, which are laid out upon a rectangular plan, the thoroughfares running in one direction are termed *avenues*, those at right angles to the other, *streets*.

Average.—1. Of medium character or quality, midway between extremes.

2. The mean of a series or collection of quantities, obtained by dividing the sum of the quantities by their number.

3. A charge upon goods, freight, etc. which is made in various forms. *Prime* and *average*, a small charge over and above the freight, formerly paid to a shipmaster for his care of the merchandise. *Petty average*, a payment on account for such services as towage, pilotage, etc. *Particular average*, a loss or the payment on account of it, when there is no question of the general safety, but only of the particular loss, as of an anchor, or a sling of cargo falling overboard. *General average*, a general contribution levied on all shippers, in proportion to their interests, to make good a loss sustained by a part for the whole, to insure the safety of a ship or her cargo, as by loss of spars, jettison of cargo, etc.

Average Pressure.—1. The mean load in lbs. per square inch upon a piston throughout its stroke, usually taken as the mean of ten equally spaced ordinates of the indicator diagram.

2. The mean result of a series of pressures observed at regular intervals.

Avogadro's Law.—In physics, at the same temperature and pressure equal volumes of different gases contain the same number of molecules. Hence the molecular weights of gases are proportional to their densities.

Avoirdupois Weight.—The ordinary commercial standard of weights, used for nearly all articles, with the exception of precious metals and jewels. The pound avoirdupois weighs 7000 grains, and is divided into 16 ounces, each of 16 drams or $4\frac{3}{4}$ grains.

Merchants frequently use a ton of 2000 lbs. avoirdupois. For overseas traffic, or for coal, customs purposes, etc., the English measurements are employed, a ton consisting of 20 hundredweight, 80 quarters of 28 lbs. each or 2240 lbs.

TABLE.			
16 drams (dr.)	make	1 ounce,	oz.
16 ounces,		1 pound,	lb.
28 pounds,		1 quarter,	qr.
4 quarters or 112 lbs.,		1 hundred-weight,	cwt.
20 hundred-weight,		1 long ton, of 2240 lbs.	T.
2000 lbs.		1 short ton,	T.

Avow.—To declare openly, as something one is not ashamed of, or as something believed to be right, to own or acknowledge frankly, as, a man *avows* his principles.

Award.—1. To give by sentence or judicial determination; to assign, or apportion, after careful regard to the nature of the case; to adjudge; as, the arbitrators *awarded* damages to the complainant; the contract was *awarded* to the lowest bidder.
2. The paper containing the decision of arbitrators; that which is awarded.

Awl.—A pointed instrument for piercing small holes, as in leather or wood. The blade is differently shaped and pointed for various uses, as in the brad-awl, saddler's-awl.

Awning.—A cover of canvas, to shelter from the sun's rays.

Awry.—Turned or twisted toward one side; not in a straight or true direction, or position; out of the right course; distorted; oblique or obliquely; with oblique vision; as, to glance *awry*.

Axe.—1. A tool for chopping or hewing wood, or felling timber, the blade being so made that the cutting edge is in the same plane as the sweep of the implement, thus differing from the *adze*. The *axe head* is generally of wrought iron into which is welded the cutting blade or *bit* of steel; the blunt end is the *poll* (not to be confused with the *pole* of a pole-axe); the part receiving the handle is the *eye*; the handle itself is the *helve*. The varieties are named from their various uses or sizes, such as *broad-axe*, *felling-axe*, *pole-axe*.

2. A bricklayer's tool, also termed the *scrutch*, in which a double ended blade about one inch wide is wedged transversely at an angle in a wooden handle; used for cutting bricks to size or shape.

Axial.—Of or pertaining to, or constituting an axis, or *central line*; rotating on or about an axis.

Axial Flow.—A term applied to that class of turbine in which the fluid passes through the motor in a direction parallel to its axis, like the Jonval or Parsons. Also termed *parallel flow*.

Axial Pitch.—In machinery, the pitch of a screw, measured in a direction parallel with the axis. The term is specially applied to many threaded screws to distinguish the pitch of a single turn only, from that termed divided axial pitch and from the common pitch.

Axiom.—A self-evident truth, not only too simple to require, but too simple to admit of demonstration.

Axioms.—The following are interesting examples of geometrical axioms:

I. Things which are equal to the same thing are equal to each other.

II. When equals are added to equals the two or more wholes are equal.

III. When equals are taken from equals the remainders are equal.

IV. When equals are added to unequals the wholes are unequal.

V. When equals are taken from unequals the remainders are unequal.

VI. Things which are double of the same thing, or equal things are equal to each other.

VII. Things which are halves of the same thing, or of equal things, are equal to each other.

VIII. The whole is greater than any of its parts.

IX. Every whole is equal to all its parts taken together.

X. Things which coincide, or fill the same space, are identical, or mutually equal in all their parts.

XI. All right angles are equal to one another.

XII. A straight line is the shortest distance between two points.

XIII. Two straight lines cannot enclose a space.

Axis.—1. The straight line, real or imaginary, passing through a body on which it revolves, or may be supposed to revolve.

2. A straight line with respect to which the different parts of a magnitude are symmetrically arranged; as, the *axis* of a cylinder, i. e., the straight line joining the centers of the two ends; the *axis* of a cone, i. e., the straight line joining the vertex and the center of the base; the *axis* of a circle, a straight line passing through the center. Plural *axes*.

Axle.—Generally speaking, a shaft connecting the naves of the opposite wheels of a vehicle. In railway use, an axle is a bar of circular section, to which the wheels are rigidly secured, and which revolves in suitable bearings. In automobiles, the *axes* may be dead, or stationary, the wheels revolving freely on them; or else *live*, that is, driven themselves by the motor.

Axle Box.—In railway practice, the bearing in which the axle rotates; it consists of a metallic casing provided with a bronze or white metal crown bearing only, the bottom or cellar of the box being formed into a receptacle holding oil and a lubricating pad to keep the journal continuously oiled.

Axle-guard.—In railway engineering, one of the pedestals in which the boxes of an axle play vertically as the springs yield and recoil. Also called *hornplates*, *jaws*, *housings*, *pedestals*.

Axletree.—A bar or beam of wood or iron, connecting the opposite wheels of a carriage, on the ends of which the wheels revolve.

Axman.—1. One who wields an axe.

2. In civil engineering, one who drives down the stakes in the ground at the different places located by the *transit-man*.

Azimuth Circle or vertical circle.—One of the great circles of the sphere intersecting each other in the *zenith* and *nadir*, and cutting the horizon at right angles.

Azimuth Compass.—A compass resembling the mariner's compass, but having the card divided into degrees instead of rhumbs, and having vertical sights, used for taking the magnetic azimuth of a heavenly body, in order to find, by comparison with the true azimuth, the variation of the mariner's needle.

Azimuth Dial.—A dial whose stile or gnomon is at right angles to the plane of the horizon; used in navigation and surveying.

Azote.—The French name for *nitrogen*, frequently encountered in scientific articles translated from that language. *Azotic acid* is nitric, *azote of potash* is potassium nitrate, etc.



B.—The second letter of the English alphabet.

Babbage, Charles.—

Born 1792, died 1871. An English mathematician and scientific mechanician. In 1822 he constructed a small machine that would calculate simple formulas and the next year he obtained a grant for making a calculating machine based on the method of differences, but meeting serious hindrances in the work of construction, he thereupon improved his designs (1834), but the Government considered it too expensive to build and he was never able to complete it; he devoted 37 years of his life and a large part of his fortune in his effort to perfect his machine. He made many contributions to the science of mathematics, and published numerous scientific works of value.

Babbitt.—In machinery, to line, bush, fill or face with Babbitt-metal or the like; as, to babbitt a bearing.

Babbling.—In machinery, the process of lining bearings with Babbitt-metal, or with white metal.

Babbitt Metal.—An appellation loosely given in the United States to any kind of white anti-friction metal. The formula of Babbitt himself, who invented the recessed bearing is as follows: 4 lbs. of copper is first melted in one pot, 12 lbs. of tin in another; 8 lbs. of antimony regulus is added to the molten tin, the surface being sprinkled with powdered charcoal to prevent vaporization of the antimony. When melted and incorporated, the tin and antimony are poured into the copper, the pot being off the fire. This forms the *hardening* mixture. 1 pound of it is added to 2 pounds of tin, thus forming as a whole, 4 lbs. copper, 8 lbs. antimony, 96 lbs. tin. The metal is then cast into ingots.

Bac.—1. In navigation, a broad flat-bottomed ferry-boat, adapted for conveying horses and carriages, and usually navigated by a rope fastened on each side of the stream.

2. In brewing, a cistern with a perforated metallic bottom, used for straining the hops from the beer previous to its entrance into the cooler. Also written *back*.

Back.—1. To cause to move backward; reverse the action of; as to *back* an engine; to force back.

2. Situated in the rear; being behind or back of anything; the part opposite the front.

3. In metal mining, the unworked portions of the lode which are laid open and ready for mining.

4. In coal-mining, the rear of a heading or working face.

Back Bar.—A bar in a fire place to hang a kettle on, called also *runule-bar*.

Backboard.—In hydraulics, a board attached to the rim of a waterwheel to prevent the water from

running off the floats or paddles into the interior of the wheel.

Back-center.—In machinery, the pivot or dead center, upon which the back or tail end of the mandrel of a lathe headstock runs.

Back Cutting.—In civil engineering, the earth obtained for a canal or railroad bank, when the excavated earth does not suffice for a regular *cut and fill*.

Back-draught.—A rush of flame or smoke from the door of a furnace or the front of a fireplace, occasioned by obstruction of the chimney, shutting off the blast as in a locomotive, or the wind blowing down the chimney.

Back-end.—1. In marine engineering, the combustion chamber of a return-tube boiler.

2. In locomotive practice, the crank-pin end of the connecting rod.

Backer.—In slating, a narrow slate laid on the back of a broad, square headed slate, at the spot where a course of slates begin to diminish in width.

Back Fall.—In paper-making, the slope of the bedplate of a beating engine away from the breasting, down which the rags or half stuff falls after passing the roll.

Back Fire.—1. A small explosion caused by reversal of the explosive mixture in an internal combustion engine, the flame passing into the inlet and possibly to the carburettor.

2. An explosion caused by turning on liquid fuel into the atomizer before applying a light to the latter, thus causing accumulation of explosive gas within a furnace, which explodes as soon as an attempt is made to ignite the flame.

Back Gear.—A train of gear wheels fitted to the headstock of a lathe or

other machine tool, whereby the speed of the mandrel is reduced very much below that of the cone pulley, thus increasing the power of the machine.

Background.—The remote part of a picture; also the ground coloring, upon which ornamentation is displayed.

Back-guys.—In rigging, the wire or manilla ropes which hold the top of a derrick from falling forward, and distinguished from the *side and front ropes*.

Backing.—1. In masonry the coursed masonry next to the extrados of an arch and resting thereon.

2. In manufacturing, the web of coarser or stronger material at the back of such goods as velvet, plush, etc.

Backing-off.—The operation of relieving or beveling off the backs of the teeth of milling cutters, or of beveling the *leaving edge* of the threads in a tap. The object in either case is to afford clearance for the cutting edge, thus making it do its work more neatly, and preventing the choking of the tool with chips.

Backing-up Flange.—In machinery, a collar on a pipe by which the latter is held to its bearing or seat.

Back-lash.—1. In machinery, the reaction of striking back of a piece of machinery, wheel, piston, etc., when the power makes a temporary pause, or a change of motion occurs. It is a consequence of bad fitting or wear, and in the latter case, indicates that the parts should be set up. The gib, cotter, and strap of the pitman connection are instances of provision for said readjustment. In some cases, springs are arranged to keep the parts in positive contact, so that no reflex motion occurs to be taken up suddenly when the power is again applied.

2. In rigging, a piece of rope for holding a hoist of iron or lumber in a position so that it will not slip through the sling.

3. A shop term for the lost motion caused by the wearing of screw-threads, knuckle-joints, etc.

Back Pressure.—In a steam engine, the pressure on the opposite side of the piston, which opposes a resistance to the working stroke of the steam. This back pressure may be due to the pressure in a receiver, as in the high pressure cylinder of a compound engine; to that of the atmosphere, as in a non-condensing engine; or to that of an imperfect vacuum as in a condensing engine.

Back Pressure Valve.—A valve designed to prevent the reflux of liquids or fluids in a pipe, resembling a check or non return valve. Especially used with heating systems.

Back-rest.—In machine shop practice, a guide attached to the slide rest of a lathe and placed in contact with the work, to steady it in turning.

Back-saw.—A miter or tenoning saw, with a steel or brass back to the blade to stiffen it.

Back-set.—1. A check; a relapse; a discouragement; a setback.

2. Whatever is thrown or forced back in its course, as water.

Back-stay.—1. A stay from a mast to the vessel's side, slanting aft, to assist the shrouds.

2. In machine shop practice, the *steady-rest* behind the turning tool in a lathe.

Back Steady-rest.—A lathe traversing rest, distinct from the slide rest, used for the support of long shafts, and of slight cylindrical pieces of work generally, which are being turned up. A common form consists of an internal bearing or angle-block attached to a vertical carrier or bracket, the bearing being adjusted both above and behind the shaft where the tendency to spring is greatest during the turning process. Also called a *back-stay*; or *back following stay*; or *following steady*.

Back-stopes.—In mining, overhand stopes; those in which the material is so excavated, in a working, that it looks like a flight of steps seen from underneath.

Back Stream.—In hydraulics, a current running against the main current of a stream; an eddy.

Backward Eccentric.—In steam engineering, that eccentric, of the pair which constitute a link motion, which drives the valve gear when the motion of the engine is reversed, or it is in *backward gear*.

Backwater.—1. An arm of the sea or creek so called because there is no outlet save the entrance, and the waters have to return to the sea.

2. A parallel channel of a river, shallower or less important than the main stream.

3. The water accumulated or impounded at high tide for the purpose of flushing out channels, docks, etc., at low tide, thus obviating dredging.

Badigeon.—1. A mixture of plaster, stone powder and coloring matter, mixed with water to a paste, used for stopping holes, cracks and bad places in statuary or stone work.

2. Also a compound of sawdust and glue for repairing defects in woodwork.

Baffle-plate.—A thin plate or diaphragm used to deflect or retard the course of gases, etc., as the baffle-plates inside a furnace door, or those fitted on the tubes of a water-tube boiler.

Bag and Spoon.—A system of dredging used alongside dock walls or in other constricted positions where a steel rim or *spoon* is manipulated at the end of a pole or staff twenty to thirty feet long. A *bag* is laced to the spoon and brings up the dredgings.

Bagasse.—The sugar-cane when crushed and dried; used as fuel.

Bagasse Furnace.—A furnace for burning bagasse, or sugar cane remaining after the pressure of the saccharine juice therefrom. It generally consists of a kiln or large chamber with a flue to the furnace space beneath the boilers.

Baggage.—The personal effects of a traveler, trunks, clothing, etc. The tents, utensils and other necessities of a military body.

Baggage Car.—A railway car for the transportation of the baggage of passengers.

Bagging.—In manufacturing, a coarse fabric made of old ropes, hemp, etc.

Bag Holder.—A machine or device for holding an empty sack upright, while it is being filled with grain or the like.

Bag Pump.—In hydraulic engineering, a form of bellows pump in which the valved disk which takes the place of the bucket, is connected with the base of the barrel by an *elastic bag* distended at intervals by rings.

Bail.—The swinging semi-circular cross-handle of a bucket, or any stirrup-shaped piece resembling in appearance or use such cross-handle.

Bailer.—The sand pump or bucket used to remove water and detritus from artesian wells during boring operations; usually consisting of two lengths of casing screwed together with a clack valve in a removable cup at the bottom, and a cross-bail, furnished with a pole joint, at the top.

Bailing Machine.—In hydraulic engineering, an apparatus consisting of a

square bucket, sliding on a nearly vertical rabbeted beam, dipping at its lower position into the water in the hold or ditch, and discharging its contents upon deck or bank.

Bake.—1. To prepare as food, by cooking in a dry heat, either in an oven or under coals, or on heated stone or metal.

2. To dry or harden anything by subjecting to heat; as to *bake* bricks; the sun *bakes* the ground.

Balance.—1. In physics, a state of equilibrium or counterpoise; said to exist when the forces and momentum of a mechanism are so adjusted that motion is uniform and unattended by vibration or percussion.

2. A delicate form of scales adapted for the minute measurements of chemical and experimental work. One in the Royal Mint in London is so delicate that it shows the difference in weight occasioned by writing one's name with pencil on a previously weighed piece of paper.

Balance Bob.—In steam engineering, a weight on the inner end of a working-beam, to counter-balance the weight of the plunger piston.

Balance Box.—The weighted box running on the projecting tail of a crane, which serves to balance the load.

Balance Bridge.—In civil engineering, a lifting bridge, with a counter-balance, which, when the bridge is opened, lowers in a pit built in the abutment.

Balance Crane.—In machinery, a crane in which the load is counter-balanced by a weight attached to the tail or hinder end, the amount of weight depending on the distance at which the load is lifted, the length of the tail, and the disposition of the mass of the crane itself. Balance cranes are made both fixed and portable and are worked by hand or power.

Balance Cylinder.—A small vertical cylinder mounted on the top of the valve chests of large marine or similar engines. The piston, working within this cylinder is attached to the top of the slide valve spindle, and the steam pressure on its surface is sufficient to sustain the greater part of the weight of the valve and spindle, thus relieving the eccentrics of much of their load. A pipe communicates with the condenser from the upper part of the balance cylinder, removing any leakage past the piston and assisting the balancing.

Balanced Pulley.—One in which the parts are equally weighted, both for *running* and for *standing* balance. All rapidly revolving pulleys require to be balanced.

Balanced Valve.—A slide valve in which the pressures upon the opposite sides are equalized as much as possible in order to lessen friction and the power necessary to operate the valve. The balancing is generally effected by means of strips or rings, which are held up by springs from the back of the valve, working against a planed surface on the valve chest cover, etc. The area enclosed within the strips or rings is thus freed from the steam pressure, and any possible accumulation of pressure, through leakage, is obviated by a cock leading to the atmosphere or to the condenser. Also called an equilibrium valve.

Balance Gate.—In hydraulic engineering, a form of flood gate which has a vertical shaft as a center. As the leaves on each side of the pintle are of equal area, a very small power is necessary to open them in whichever direction the water may be pressing. By giving a preponderating area to the inner leaves of the gate, they may be made self-opening or self-closing as the current sets in or out of a channel. In this form they are commonly used as *sluice gates*.

Balance Gear.—The differential gear of an automobile.

Balance Level.—In surveying, an instrument suspended by a ring. When in equilibrium, two sights, properly fitted to the instrument, show the *line of level*.

Balance Rynd.—In millwrighting, the bail or bridge piece with which a top-runner millstone is poised upon the spindle. The *cock-eye* or recess for the point of the spindle is in the concave side of the bail which straddles the opening or eye of the stone at its lower face. The *damsel* is worked by the *balance-rynd*.

Balance Wheel.—1. In machinery, a wheel which imparts regularity to the movements of any engine or machine; a *fly wheel*.

2. In watchmaking, a wheel which regulates the beats or pulses of a watch or chronometer, answering to the pendulum of a clock; often called simply, a *balance*. Also a ratchet shaped escape wheel, which in some watches is acted upon by the axis of the balance wheel proper.

Balancing.—In mechanics, the removal of irregularities in weight from those portions of a revolving body where it is in excess, in order to equalize the strains upon it due to momentum and centrifugal force. Hence rapidly revolving pulleys and wheels are, where possible, turned all over. When that is not practicable they are hung on a free spindle and the weight of the heaviest sides reduced in succession by drilling out holes, or in other ways removing superfluous metal. Such a pulley or wheel is then said to be balanced. Another mode of balancing is when a balance weight is attached to a driving or a fly wheel to counter balance the mass of a crank, or an eccentric sheave, or similar projecting portion on the axle. All good mechanisms and rapidly revolving parts are thus balanced.

Balconet.—In architecture, a low ornamental railing to a door or window, projecting but slightly beyond the sill or threshold. It is mainly used in the Swiss style of architecture.

Balcony.—In architecture, a projecting stage or platform on the outside of a building, usually supported by columns, and furnished with a protecting rail.

Baldwin, Matthias William.—Born 1795, died 1866. An American inventor and manufacturer. In his youth he developed a mechanical bent, and was for some years engaged in the design and manufacture of jewelry and the construction of the machinery of his trade; but in 1825 he established a plant for the making of bookbinding tools and machinery, a business which soon branched into wider fields necessitating constantly improved machinery and greater power. In 1828 he built a five horse-power stationary engine which was superior to anything hitherto in use. This led to the manufacture of steam engines exclusively, and after 1830 he devoted himself to the development of the American locomotive, completing his first locomotive engine in 1832; thereby laying the foundation of the industry which grew to great proportions in the Baldwin Locomotive Works. Mr. Baldwin was active in the founding of the Franklin Institute in Philadelphia in 1824, and conspicuous in charity and benevolence.

Bale.—A large bundle of raw material or merchandise prepared for shipment, usually by compression and secured with hoop-iron bands. A *bale* of American cotton weighs from 400 to 500 lbs. according to season and locality, a *bale* of compressed hay about 200 lbs.

Bale-hook.—A sharp pointed sickle shaped hook with a wooden T-handle, used by stevedores and porters to get a grip or purchase on bales of merchandise. Also known as *box hook*.

Bale-scoop.—A scoop or pivoted trough, designed for draining bodies of water. The outlet end is pivoted on the bank or shore and the other end is, by means of a long lever, dipped in the water, and when sufficient water has run, lifted up and its inclined position causes the water to run off.

Baling-press.—A hydraulic or power-press employed for compressing soft or fibrous materials; such as hay, raw cotton, cotton and woolen goods, etc.

Balise.—A timber frame raised as a beacon or land mark. Also spelled *balize*.

Balk.—A square piece of timber, such as is used in constructing *stujings*, etc. A square log of fair dimensions, usually roughly dressed to size, used in erecting.

Ball.—1. A sphere; a globular body or mass.

2. The bloom, or round globular mass of plastic iron produced by the process of *puddling*.

Ball and Socket Joint.—A joint in which a ball or spherical object is placed within a socket recessed to fit it, thus permitting free motion in any direction within certain limits. A ball and socket mounting is usually applied to shafting supports to make them self-adjusting.

Ballast.—1. Weight carried to insure stability; a ship is said to be *in ballast* when she carries no cargo.

2. Crushed or broken stone, such as was formerly carried as ballast by sailing ships, as used for any purpose; road making, concrete mixing or the like.

3. In railway construction, packing of gravel, broken stone or similar material, which surrounds railway ties or sleepers, and holds them in position.

Ballast Pump.—In navigation, an auxiliary steam pump used to discharge a ship's water ballast. Also known as *ballast donkey*.

Ballast Tank.—A compartment, usually in the double bottom of a steamship, in which water ballast is carried for the purpose of insuring the proper stability of the vessel, and trimming her so as to secure the greatest effectiveness of the propeller.

Ball Bearing.—A bearing whose journal works upon rings of balls, which roll easily in their grooves or *races*. Friction upon a series of points is thus substituted for that upon a surface, thus eliminating a considerable amount of the total friction. The balls are made of hard cast-iron or steel. Fins and spurs are removed on an emery wheel, then they are ground to shape within a series of tumbling barrels, the first barrel being filled with balls and *slut*, the next with balls and *emery*, the last with balls, *flour emery* and *leather clippings*.

Ball Cock.—A faucet which is opened or closed by means of a hollow copper ball, floating on the surface of the water, as it rises and falls in the cistern with the changes of level; a *float*.

Ball-cutter.—In machine shop practice, a spherical cutting tool; a cutter with a rounded edge.

Ballistic Pendulum.—An apparatus used to determine the velocity of projectiles of cannon and small-arms. The original instrument consisted of an iron bar suspended by a transverse axis, and having a block of wood strengthened with iron plates to receive the impact of the ball. The percussion causes the pendulum to vibrate, and the extent of its motion as measured by a needle moving over a graduated dial, affords a measure of the energy of the projectile.

Ballistics.—The science that deals with the path, velocity and impact of projectiles.

Ball-joint.—A universal joint, sometimes employed in piping. The globular end is retained in its hollow seating with a gland screwed over it. This form of joint is used with the connections of centrifugal and other pumps.

Ball Mill.—A disintegrator or ore-crusher, in which the material to be operated upon is placed within a rotating cylinder together with numerous balls of metal or flint, which, by percussion and grinding, reduce it to powder.

Balloon.—An air-tight envelope of silk, linen or other similar material, usually pear shaped, which, upon inflation with illuminating gas rises in the atmosphere and may carry considerable weight, the amount of which depends upon the difference between the weight of the gas and that of the volume of air which it displaces. In order to furnish as small a target as possible, military balloons are generally constructed of gold beaters skin and inflated with pure hydrogen, which has a much greater lifting power than coal gas.

Balloon Boiler.—A name given to an old type of externally fired boiler, shaped not unlike a balloon, with the upper half in the form of a hemisphere, and the lower part an inverted conical frustum. This shape of boiler was also known as *haystack*.

Balloon Framing.—In carpentry, a cheap and rapid method of constructing timber houses, used instead of the braced frame, wherein all timbers are properly tenoned and fitted to each other. With the balloon frame the timbers are of light scantling and are held together entirely by nails and spikes, the corner posts alone being tenoned.

Ballooning.—In steam engineering, the lifting up of fine impalpable mud and scale in boilers to the surface of the water by the ebullition of the bubbles of steam. In certain boilers, scum troughs are provided for the collection of this sediment.

Balloon-jib.—In navigation, a light triangular sail between the fore-top-mast-head and the jib-boom end; used only by yachts and in light winds.

Ball-pane.—In machinist work, the smaller or narrower end of a hammer head. It is termed a ball-pane when it is spherical in form, also spelled *ball-pene*.

Ball-pane Hammer.—A common type of hand-hammer, in which the *pane* or point, is in the shape of a ball, thus rendering the tool serviceable for riveting, etc.

Ball Race.—In mechanics, the track or groove which contains the circle of balls for a ball bearing.

Ball Stamps.—Direct acting ore crushers, much resembling a steam hammer, in which the blow of the stamp is increased by the force of steam.

Ball Turning.—The art of producing spherical objects in the lathe, which is generally designed for the production of cylindrical forms. The operation is performed either with curved tools, the tool post swinging through a circular arc; or by manipulating the compound rest so that the object is turned as an approximate sphere, the angles being removed by a wide tool, and an accurate surface obtained by finishing with a spring tool of mathematical correct shape.

Ball Valve.—A type of non-return valve frequently employed in borehole pumps, and for small check valves. It consists of a globe or ball, of steel or bronze, working on a cup-shaped seat, usually within a suitable cage. The advantage of the ball valve is that it is always shifting on its seat, thus keeping itself and the seat true with each other.

Balm.—The resinous and aromatic exudation of certain trees or shrubs.

Balneum.—A vessel filled with some heated substance, as sand or water, in which a thing is placed for treatment that requires a more gentle heat than the naked fire; as, in tempering steel or brass.

Balsa.—A ship's life-raft consisting of a platform supported on logs or metal cylinders.

Balsam.—A resin containing more or less of an essential or volatile oil, used as a medicine.

Baluster.—1. In masonry, a small short column or shaft, connected in a series, by means of capping, to form a protective railing or guard.

2. In carpentry, a slender upright column supporting the handrail which guards the side of a staircase or the like. Also termed *banister*.

Balustrade.—A series of balusters, capped with a rail, serving either as ornament, or for a protection along the edge of an elevated platform or terrace.

Bamboo.—The stalk of a giant grass, of which there are many varieties. The bamboo is used for very many purposes, particularly in the East, where it furnishes building material and is the source of a number of domestic articles.

Banca Tin.—Tin ore from Malacca and Banca; it is the purest ore known and is valued accordingly. It is sold in blocks weighing from 40 to 120 lbs. each.

Band.—1. In mechanics, a driving belt.

2. A thin strap of metal or other material secured around the circumference of anything, either as ornament, fastening, or to serve some mechanical use.

Bandage.—1. A strip, usually of soft cloth, used in dressing wounds.

2. In architecture, an iron ring or chain about a dome or tower to hold it together and prevent spreading.

Band-brake.—A curved friction-piece for pressing against a wheel to stop its turning around.

Band-friction.—The friction existing between a driving belt and its pulley; that which communicates motion from one wheel to another by friction alone.

Band Saw.—An endless band of steel, with saw teeth upon one edge, passing over and driven by two wheels.

Band-wheel.—A pulley, over which a belt runs, or upon which a band-saw is mounted.

Bandy.—In carpentry, bent, crooked; curved laterally, especially with the convex side outward, as a *bandy girder*.

Bang.—1. A blow as with a club; a heavy blow.

2. The sound produced by a sudden concussion.

Banjo-frame.—An open kite-shape connecting rod, made either in one piece—cast or forged steel—or else composed of separate parts bolted together. This type of rod is used on many varieties of steam-pumps, in certain valve-gears, and occasionally as connecting rods of locomotive cranes, etc.

Bank.—1. Any ridge or mound-like formation or mass; as a *bank* of earth.

2. In carpentry, a long piece of timber from four to ten inches square; usually in a rough condition.

3. A grade, as, on a railroad; an embankment.

4. The surface of the mouth of a pit-shaft; thus, the output is described as so many tons of coal brought to *bank* daily.

Banker.—In masonry, a bench used by bricklayers in dressing bricks to a shape suitable for skew or gaged work, domes, niches, etc.

Banking Engine.—A locomotive especially detailed to assist trains up heavy inclines or *banks*.

Banking Fires.—A practice adopted to check combustion, where steam has to be maintained in readiness in boilers, as on a steamship. The fires are raked to the front of the furnace, and smothered with ashes or slack coal, the suppressed combustion of the interior affording sufficient heat to maintain the heat of the boilers while no steam is being used.

Banking Up.—1. In blacksmithing, the beating down of green coal around the central portions of a smith's fire, or around a piece of forging laid therein.

2. In steam engineering, the covering up of the fire of a boiler in order to check or moderate the formation of steam for a time, either because the engines have to be slowed down or stopped for a while. Banking up is effected by pushing the fuel back towards the bridge and covering it over with small coal, wetted and beaten down.

Banksman.—In mining, a man who stands at the mouth of the shaft, attending to the *kibble* when it is drawn up, and seeing that it is emptied in the proper place.

Bar.—1. An obstruction at the mouth of a river, etc., occasioned by the deposition of the sand, mud, or other water-borne material brought down by the river current.

2. In placer mining, a bank of sand or gravel in or near the bed of a river or stream.

3. A piece of metal, or other solid material, usually long in proportion to its width and thickness; as, a *bar* of iron, the *bar* of a window sash.

Barb-bolt.—In machinery, one having jagged edges to prevent retraction after driving; a *rag bolt*.

Barbed Wire.—Two or more strands of steel wire twisted together, with sharp pointed barbs or hooks clenched or interwoven between them at uniform distances; the whole is galvanized after manufacture. The use of this material is regarded as indefensible, except in cases of absolute necessity, such as for entanglements in time of war.

Bar-channeller.—A quarry channelling machine, in which the cutting head travels along a *bar*, thus doing away with a rail track for the machine, and permitting vertical, horizontal or inclined channels to be cut.

Bar-clamp.—In tools, a tool used for the purpose of clamping or squeezing closely together long timber joints, which are glued or doweled; the jaws of the clamp operating on the outer edges of the wood. It consists essentially of a long bar of iron of rectangular section, having a fixed head or jaw at one end, carrying a square threaded pinching screw and a movable head or jaw sliding along the bar, and capable of being set in any position at distances of from two to four inches apart by means of a pin, or by ratchet teeth. The movable head being set in the approximate position required for various widths of board, the pinching up of the clamping screw in the fixed head affords the necessary degree of pressure.

Bare.—1. In architecture, that part of a roofing, slate, shingles, tile or metal, which is exposed to the weather.

2. A shop term applied to a scant measurement, thus a bar measuring 0.99 inch in diameter would be termed one inch "*bare*." The converse is *full*, meaning oversize. Both terms are used when the measured dimensions of a piece do not equal even sixty-fourths or thirty-seconds.

Bare Pump.—A portable suction pump for drawing liquid from casks. Such are used in vinegar works and by merchants for sampling. The piston is hollow and carries a spring valve, which closes as the piston rises, and opens to allow the air to escape as the piston descends.

Barff's Process.—A process employed to protect iron from rust. The iron is first heated to redness, and steam is then passed over it. The steam being decomposed by the iron, oxygen is liberated which immediately attacks the iron and forms a protective coating of magnetic or black oxide.

Bar-frame.—In furnace construction, the frame which supports the ends of the grate bars.

Bargain.—1. An agreement between parties concerning the sale of property; or a contract by which one party binds himself to transfer the right to some property for a consideration, and the other party binds himself to receive the property and pay the consideration.

2. The thing stipulated or purchased; also, anything *bought cheap*.

Barge.—1. A flat-bottomed freight-boat, chiefly for canal and river navigation; either with or without sails or steam power—in the latter case called a *lighter*.

2. The second boat of a man-of-war, generally intended for the use of the higher officers.

Bar-iron.—A shop term for wrought iron when rolled into long bars of plain sections or *round, flat, square*, etc.

Barium.—A heavy metal of a pale yellow color, one of that group whose oxides form the alkaline earths, such as calcium and strontium. It is not known in a native condition, being generally obtained from its sulphate; its melting point is about that of cast iron.

Bar-keel.—A ship's keel which consists of a heavy single bar of steel or iron.

Barker's Mill.—A form of reaction wheel or turbine invented in the seventeenth century by Dr. Barker. The water flows into a vertical tube and gushes from apertures in hollow horizontal arms, causing the machine to revolve backward on its axis.

Barking Mallet.—A short handled mallet of hard wood. The face is about three inches square, and the other end is sharpened to a *peen* or *wedge*.

Barking Tools.—For removing the bark of trees for tanning purposes. Besides the axe or hatchet for slitting the bark longitudinally and for-cutting incisions around the trunk, which enables it to be removed in lengths, the *barker* requires *peeling irons* which are thrust beneath the bark to loosen it. The operation is performed in spring when the sap is abundant between the bark and the wood. These tools are also used when *barking piles* before they undergo the process of creosoting and other *pile coating* preparations.

Bark Mill.—In tanning, a mill for grinding bark which is to be used in tanning leather.

Barkometer.—A hydrometer or instrument for measuring the strength of an infusion of *tan-bark*.

Bark Pit.—In tanning, a vat partly filled with bark and water, in which hides are steeped in the process of tanning.

Bark-rossing Machine.—In tanning, a machine for removing the *ross*, that is the rough, scaly portion from the outside of bark. The *ross* has a lesser proportion of tannin, and by its removal a steep of greater strength may be obtained and vat room saved.

Barley Corn.—A grain of barley, about the third part of an inch in length; hence, its origin as a measure of length.

Barley-mill.—In milling, a mill for decorticating barley; bringing it to the condition known as *pearl barley*, the husk or the rind of the seed being removed. To accomplish this it is necessary to so regulate the distance between the ordinary runner and the bed stone that the grain is not mashed, but the bran rubbed off.

Barn.—A covered building used chiefly for storing grain, hay and other productions of a farm, and of which a part is often used for stables.

Barnacle.—1. A shell fish or any crustacean adhering to rocks, timber, ships, etc.; especially the *sessile* species and the *stalked* and *goose* barnacles.

2. In blacksmithing, an instrument for pinching a horse's nose, and thus restraining him.

Barney.—A small dump car used in the Pennsylvania anthracite mines.

Bar of Ground.—In mining, a vein running across a lode.

Barograph.—A recording barometer, in which the motions of an aneroid are conducted by linkwork to a tracing point, moving it over a traveling roll of graduated paper, thus registering variations in atmospheric pressure.

Barometer.—An instrument for measuring the pressure of the atmosphere. The mercurial is a glass tube 33 to 34 inches high, sealed at the top, filled with pure mercury and inverted in an open cup of mercury. A graduated scale on the instrument permits observations of the fluctuations in the height of the mercurial column, which is highest when the atmosphere is dry, weighing more than when saturated with aqueous vapor, which is lighter than air. The height of barometric measurement is about 30 inches.

Barque.—A three-masted vessel, square rigged on the fore-and-main, and fore-and-aft on the mizzen. Sometimes written *bark*.

Barquentine.—A three-masted vessel, square rigged on the fore, and fore-and-aft rigged on the main and mizzen.

Barracan.—In manufacturing, a thick, strong stuff, known by this and similar names in most of the languages of Europe and western Asia. It is made in Armenia and Persia of camels hair like *camel*, whose name also indicates that the material is derived from the same animal. The name has been preserved, while the fabric has been made of other materials, as, wool, flax or cotton.

Barracks.—In civil engineering, a temporary building for quartering workmen. Permanent buildings, also, designed exclusively for occupancy by soldiers, are generally so called. Also a structure erected for sheltering workmen where work is progressing in an isolated position, to which access is difficult; as, the construction of lighthouses on cliffs.

Barrage.—A masonry dam built across a river or water course, to increase the depth of water above it, for irrigation purposes, etc. It is provided with sluices, etc., to regulate the flow, so as to maintain a predetermined level.

Barrel—1. A nearly cylindrical vessel, usually slightly bulging in the middle, and generally made of wooden staves held together by hoops.

2. A measure of quantity applied both to liquids and to solids, varying in different places and for different materials. The standard U.S. wine barrel holds 31 gallons, a flour barrel 196 lbs., an apple barrel 2½ bushels, etc.

3. In steam engineering, the cylindrical portion of the locomotive boiler extending from the fire box to the smoke box.

4. In navigation, the main piece of a capstan, between the whelps and the pawl rim.

5. A cylindrical part of a machine; as, the main part of an engine or pump cylinder in which the working bush or liner is set.

6. The cylindrical tube of a fire-arm. The barrels of a shot-gun, when bored tapering towards the muzzle, are said to be *choke-bored*, if parallel they are *cylindrical* or *cylinder*.

Barrel of a Boiler.—The cylindrical part containing the flues.

Barrel-screw.—In ship-building, a form of screw-jack used in a ship-yard to move heavy timbers or assist in launching.

Barrel-washer.—A machine in which casks are cleaned after use, preparatory to refilling. The process is done by an arrangement that holds the barrels in a slanting position, while by their motion the water obtains a swashing motion endways of the barrel, by which its interior is cleansed.

Barren.—Unproductive; fruitless; unprofitable; empty; as, a barren island.

Barrette File.—A triangular file used by toolmakers and diesinkers, which is cut on the bottom only, the other two sides being *safe edges*.

Barring.—1. In steam engineering, the turning round of an engine fly wheel with an iron bar, to get the engine over the dead center in readiness to start. Points of leverage are afforded by fixed pins, suitably placed adjacent, and a few holes are drilled in the fly wheel to take the point of the bar. Also the initial turning of a large engine by a smaller engine.

2. In a foundry, poking away lumps of fuel from the immediate vicinity of the tuyere holes of a cupola, an iron bar being thrust through the *sight hole* for the purpose, in order to make a free passage for the blast.

Barring Engine.—A small auxiliary engine used to revolve large stationary engines, either to turn them in the proper position for starting, or to move them during overhaul. These engines, which fulfil the functions of the marine *turning engine*, are usually fitted with a contrivance which throws them out of gear as soon as the main engine moves under its own steam.

Barrow.—1. A support having handles, and with or without a wheel, on which heavy or bulky things can be transported by hand.

2. In salt works, a wicker case in which salt is put to drain.

Barrow-ladle.—A foundry ladle mounted on a low carriage provided with two wheels in front, and handles and legs at the hinder part. Used for wheeling melted metal about the foundry.

Barrow Pump.—In hydraulics, a combined suction and force pump, rendered portable by being mounted on a two wheeled, barrow-like base, and adapted for use where a frequent shifting is required.

Barrow Run.—A temporary way or run, constructed of 12" x 3" planks supported on trestles or box horses. Such a *run* greatly facilitates the removal of excavated material, as a barrow which will take only two cubic feet on the ground, can carry three feet on a plank.

Bars.—In paper-making, the knives with which the rolls of the washing and beating engines are armed. Also known as *roll-bars* and *fly-bars*.

Bar-shear.—In metal working, a machine for cutting metallic bars. It consists of a strong frame, having a fixed lower blade and a vertically reciprocating upper blade, between which the bar is sheared.

Bar Stay.—A term applied to the steam space stays in a boiler, which bind the two end plates together; so called in distinction from the stay bolts or screwed stays which sustain firebox or combustion chambers.

Barter.—1. The act or practice of trafficking by exchange of commodities; an exchange of goods.
2. The thing given in exchange.

Bar Train.—In iron manufacture, the train of rolls for making bar iron or steel of commercial qualities and sections.

Barytes.—Sulphate of barium, from which most of the barium compounds are derived. It is met with in colorless or tinted rhomboidal crystals, and is common as a gangue mineral in lead bearing veins.

Basalt.—1. A rock of igneous origin, consisting of feldspar, with grains of magnetic or titanite iron, and also bottle green particles of olivine frequently disseminated. It is usually of a greenish black color, or of some dull brown shade or black. It constitutes immense beds in some regions, and also occurs in veins or dikes cutting through other rocks. It has often a prismatic structure, as at the Giants Causeway, in Ireland where the columns are as regular as if a work of art. It is a very tough and heavy rock, and is one of the best materials for macadamizing roads.
2. An imitation in pottery of natural Basalt, a kind of black porcelain.

Bascule Bridge.—A form of balanced or see-saw bridge, in which the overhanging or river part is balanced by heavy counterweights on the shoreward end. The bridges are generally made with two leaves, one on either side of the water, and, when desired to be opened, the two halves are brought nearly vertically on end, the shoreward portions swinging in a pit. The great advantage of a bascule bridge is the absence of long, expensive approaches. The Tower bridge in London and the bridges on the Chicago Drainage Canal are examples.

Base.—1. The bottom of anything, considered as its support, or the part of a thing on which it stands or rests; as, the base of a column.

2. In chemistry, a body which can combine with an acid to form a salt. Bases are classified as follows: (1) Oxides, such as quicklime or magnesia; (2) hydrates, as caustic soda, or slacked lime; (3) a class represented by ammonia and its derivatives. Certain bases are

caustic, possess an alkaline or astringent taste, and turn red litmus paper blue, these being more popularly known as *alkalis*.

3. Spurious; anything inferior passed off as valuable; as, *base* coinage, *base* metal.

Base-bearing.—A term sometimes used by automobile engineers for the pillow or plunger blocks which support the different shafts on the chassis.

Base Burning.—A principle applied to stoves, heating furnaces, etc., in which the fire is *beneath* the fuel bed, the combustible being fed upon the top of the bed by means of a self-acting hopper or similar means.

Basement.—That portion of a house or other building which is situated at or slightly below the ground-level, as distinguished from the *cellar*, which is within the foundations or beneath the ground level.

Base Plate.—A heavy iron piece used as a foundation for a machine; specifically, a casting, provided with horizontal adjusting wedges, which is used to support pillow-blocks when mounted in wall boxes or on pedestals.

Basic Bessemer Process.—The process discovered by Thomas and Gilchrist, wherein a mixture of lime and magnesia (or *basic* oxides) is used as a lining for the converter instead of ganister, powdered flints or other siliceous or *acid* material. Any phosphorus in the iron is taken up by the basic lining and becomes slag, which is a valuable fertilizer. This renders the steel free from the fatal defect of containing phosphorus, while with the older acid process, either bad steel was produced, or else it was necessary to use ores free from phosphorus, which are comparatively rare and costly.

Basic Process.—Making Bessemer open-hearth steel in converters or furnaces lined with a *basic* or non-acid material, such as dolomite. This material combines with the phosphorus and silicon to make *basic slag*, which constitutes a valuable fertilizer, the waste of the lining being repaired by means of dolomite added with the charge of metal.

Basin.—1. In mine engineering, an isolated or circumscribed formation, on all sides toward the center; especially applied to the coal formations, called *coal basins* or coal fields.

2. A hollow place containing water; as, a pond, a dock for ships, a little bay.

Basis.—1. The foundation of anything; that on which a thing rests.

2. The pedestal of a column, pillar or statue.

3. The groundwork; the first or fundamental principle; that which supports.

Basket.—A receptacle constructed of interlaced osier, withes, etc., used for a variety of purposes. Hence, by extension, any object made of metal and resembling wickerwork in its construction, as a *fire-basket*, or brazier, *basket-work* in embossing, etc.

Basket Grate.—A fire-place, shaped like a basket, used to create draughts in the bottom of a ventilating shaft; a *brazier*.

Bas-relief.—Sculpture or carving in low relief; a species of sculpture in which the figures project very slightly, or less than half their true proportions from the surface on which they are carved.

Bass.—More properly *bast*; a strong fiber obtained from the inner bark of some varieties of the bark of the linden tree, from which Russian matting, and strong baskets, such as are used by carpenters, are made.

Basset.—In mining engineering, the outcrop or emergence of a stratum or seam at the surface.

Basswood.—A soft wood, which is capable of a fine finish, hence largely used in *trim work*.

Bastard.—1. In sugar refining, an inferior quality of soft brown sugar, obtained from the syrups that have already had several boilings.

2. A large size of mould in which sugar is drained.

3. A writing paper of a particular size.

4. A wood of the family of the yellow pine, whose grain and quality differ very much from that of the genuine yellow pine.

Bastard Ashlar.—Stones for ashlar work, roughly squared at the quarry.

Bastard File.—A file intermediate between the coarsest and the second cut.

Baste.—To sew loosely, or with long stitches; usually that the work may be held in position until fitted and afterwards sewed more firmly.

Bat or Batt.—1. A blade used in scutching hemp or flax.

2. A felted mass of fur or wool prepared by hat makers, two of which make a hat.

3. A sheet or wad of cotton after it leaves the batting machine.

Bat Bolt.—In machinery, a bolt barbed or jagged at its butt or tang, to retain it within an object cast or solidified about it.

Batch.—The quantity of anything produced at one operation; a group or collection of persons or things of the same kind, as a *batch* of concrete; the next *batch* of men.

Bateau.—A clumsy flat-bottomed boat for river service wider in the middle than at the ends; a *pontoon* for a floating bridge, etc.

Batement Light.—In architecture, a window or one division of a window having vertical sides, but with the sill not horizontal, as where it follows the rake of a staircase.

Bath.—1. A vessel holding water for washing the person by plunging or immersion. Hence any analogous receptacle, containing a liquid or fluid or molten metal, into which articles are plunged or immersed in manufacturing processes, to clean their surfaces, or to cover them with a coating of the fluid body, as in *tinning*.

2. In electroplating, a vessel containing an acid solution of some metal, in which articles are immersed for the purpose of covering them with the coat of the metal in solution, generally by *electro deposition*.

Bath Brick.—A preparation of calcareous earth, in the form of a brick, used for cleaning knives, polished metal, etc.

Bath-Metal.—An alloy consisting of four and a half ounces of zinc and one pound of copper.

Bathometer.—An apparatus for ascertaining the depth of the sea without a measured sounding line, depending upon the pressure registered against a diaphragm in a mercury-filled tube.

Bating.—A tanning process for soft thin leathers, in which they are steeped in a *bate* or fermenting solution of pigeon or dog manure; this serves to counteract the effect of the lime previously used to remove hair from the skin, and softens the latter.

Batswing Burner.—A tip or nipple for a gas jet, having a hemispherical head with a slit in it; thus throwing a wide luminous flame. Used in situations where there are many draughts, with possibility of extinguishing the ordinary *fishtail burner*.

Batten.—1. The movable bar of a loom, which strikes home or closes the threads of a woof.

2. In carpentry, strips of wood nailed across boards to hold them together.

3. A piece of wood used to fasten tarpaulins down over a ship's hatchway; the iron bars which fulfill the same purpose in modern times.

Batten-door.—A door made of boards of the whole length of the door, secured by battens nailed cross-wise.

Battendown.—In navigation, to fasten down with *battens*, as the tarpaulin over the hatches of a ship during a storm.

Battening-rule.—In civil engineering, a rule or *templet* by which the batter or slope of a retaining or breast wall is regulated while building.

Batter.—The slope given to a wall or an earthwork, either to provide a broad base for the sake of stability, or to afford the correct angle of repose for the soil.

Batterboard.—A contrivance for staking out the lines of a building or earthwork. Stout stakes are driven in pairs at each corner of the work, with a board nailed horizontally on the face of each pair. Notches are cut in the upper edges of these boards to hold the cords which mark out the various lines of the walls or excavation, thus giving a permanent and immediate reference should a line be displaced or broken.

Battery.—A term originally applied to a body of artillery with from four to eight guns, manœuvring together in field operations or in battering fortifications. Hence, the term denotes any assemblage of units, for a common purpose, which presents a resemblance to the emplaced guns of a battery; as a *battery* of steam boilers, a *battery* of sugar pans, a *battery* of ore-crushing stamps, etc.

Battery Condenser.—In gas manufacture, a series of air cooled vertical pipes, arranged in pairs, through which the gas passes on its way from the retorts to the scrubbers, parting with its suspended water and volatile hydrocarbons on account of the reduction of the temperature.

Batting.—Cotton and wool prepared in sheets; wadding; cotton wool.

Batting-block.—In pottery, a block of wet plaster on which a dab of clay is flattened out by a *batter*, to prepare it for being placed on the *whirling table*, where it is to be formed by a mold and templet into a piece of circular ware.

Batting-machine.—In cotton manufacture, a preparatory apparatus in which

the cotton after being *willowed*, is subjected to scutching, blowing, and lapping to make it into a light downy mass ready for *carding*.

Battitura.—In forging, the scales which fly off from metals while under the hammer.

Battle-dore.—In glass making, a hard tool shaped like the toy, used to form flat surfaces on the blown bulb of glass; as, in forming the base for a *caraffe*, etc.

Battlement.—A parapet around a tower, etc., in which there are openings or *embrasures*, separated by a rising part or *merlon*. First made for mounting light artillery for purposes of defence, battlements are now used for ornament.

Bauxite.—An oolitic or granular clay first found at Les Baux, near Arles. Its composition is half its weight of aluminum, with silicium as an impurity. Bauxite sometimes written *Beauxite*, is a source of alum and of aluminum. It is crushed and mixed with ordinary clay (or sometimes graphite) to form very refractory bricks and slabs for furnace linings, crucibles, etc.

Bay.—1. An inlet of the sea, usually smaller than a gulf, but of the same general character.

2. A small body of water set off from the main body; as, a compartment containing water for a wheel; the portion of a canal just outside of the gates of a lock.

3. In architecture, a principal compartment of the walls, roof, or other part of a building, or of the whole building, as marked off by the buttresses, vaulting, mullions of a window, etc.

4. In civil engineering, one of the main divisions of any structure as the part of a bridge between two piers.

5. A compartment in a barn, for depositing hay, or grain in the stalks.

6. A kind of mahogany obtained from Campeachy Bay.

7. A bank or dam to keep water back.

Bay-bolt.—A bolt with a barbed shank.

Bay-salt.—Coarse salt obtained by the evaporation of sea-water in shallow lagoons or *salterns*.

Bay-stall.—In architecture, a fixed seat within a window opening.

Bay-window.—In architecture, a window which forms a bay or recess within a room, projecting outwards from its wall in a rectangular or polygonal form. It differs from a *bow-window*, which is situated in a bow or curved projecting part of the side of the building.

BB.—An abbreviation of *Best Best*, signifying bar iron of superior quality that has been piled and rolled three times, thus securing uniformity of fiber and ductility.

Beach.—The shores of the sea, or of a lake, which is washed by the waves, especially a sandy or pebbly shore; the *strand*.

Beacon.—A signal or conspicuous mark erected on an eminence near the shore, or moored in shoal water, as a guide or warning to mariners.

Bead.—A moulder's sleeking tool, curved, with both ends rounded like a bulb, for smoothing and sleeking corrugations or beads in the mould.

Bead and Butt.—In carpentry, framing in which the panels are flush, having beads stuck or run upon the two edges

Bead-butt and Square-work.—In carpentry, framing with bead and butt on one side, and square on the other; used in *doors*.

Beaded Tubes.—The ends of boiler tubes, after being expanded are beaded or rounded, with a beading tool, just as rivet heads are finished with a die or snap. The process is termed *beading*.

Bead-furnace.—In glass making, a furnace in which glass beads are rounded after the cylinders have been cut to the proper length. The main principle of the furnace is that the glass is held in a drum, which revolves while a fire underneath burns, giving heat enough to soften the glass and still not melt it.

Beading-tool.—In boiler making, a tool used by boiler makers for finishing off the riveted ends of boiler tubes. Its shape is similar to that of a drift, except that at a short distance behind its narrow end it is shouldered out into a hollow curve which is the counterpart of the bead it is designed to mould on the ends of the tubes. The beading tool is struck by a hand hammer.

Beak.—1. Anything projecting or ending in a point, like a beak; as, a promontory of land.

2. In navigation, that part of the ship before the fore-castle, which is fastened to the stem, and supported by the main knee.

3. In architecture, a continuous slight projection ending in an arris or narrow fillet; that part of a drip from which the water is thrown off.

Beaker.—A cylindrical glass vessel, having a wide flanged foot and a lip for pouring. Much used for containing or measuring liquids in a laboratory, being generally graduated to mark its contents in cubic centimetres.

Beak-Iron.—An iron implement to fix in a bench vice or in a socket, and terminating in beaks, horns, or points; used in shaping interior surfaces in sheet metal working.

Beam.—1. Any large piece of timber or iron, long in proportion to its thickness, as used in building construction, to support the floors, etc.

2. In construction, a long, substantial bar of wood, metal or both combined, which is supported at one or more points and carries a load that may be either uniformly distributed or else concentrated at one or several points on its length. Large iron and steel beams are usually termed *girders*; a bridge may be regarded, and is calculated for, as a very large beam or girder.

3. In weaving, the loom-cylinders on which are rolled the warp or the woven cloth, known respectively as *warp beam* and *cloth beam*.

4. The greatest width of a ship.

Beam Compasses.—An instrument for describing circles too large for ordinary compasses. Ink, pencil or divided points are fixed upon a straight bar or *trammel*, which can be slid bodily along or finely adjusted by micrometer screws.

Beam Drill.—A type of drilling machine for large work, not unlike the radial drill in appearance, but having the radial arm replaced by a *beam* similar to the cross rail of a planer, supported by a post at either end. The work is mounted upon a horizontal circular table which may be either traversed longitudinally or rotated upon its axis to suit the nature of the job.

Beam-Engine.—In steam engineering, an engine with an oscillating beam to whose respective ends the connecting rod from the piston and the pitman from the crank are attached. The old atmospheric engine of Newcomen, was a beam-engine, and he is justly regarded as the inventor of the *working or walking beam*.

Beaming.—In weaving, the operation of winding the yarn upon the beam of a loom.

Bean Mill.—A mill for splitting beans, used to a great extent in coarse grinding them for animal feed.

Bear.—1. In metal working, a *portable punching machine* for iron or steel plates. A *punching bear*.

2. In navigation, a heavy block shot with matting, used to scrub the decks.

Beard.—1. In carpentry, the sharp edge of a board.

2. In manufacturing, the hook at the extremity of a needle in a knitting machine, which retains the yarns.

3. In locksmithing, a spring piece on the back of a lockbolt of the common kind to hold with a moderate pressure in either of its positions, and prevent its rattling in its guides.

Bearer.—In scaffolding, a horizontal scantling fixed across a window or door opening parallel with the *ledgers*, to serve as support for the inner end of a *putlog*.

Bearer Bar.—A transverse member in a steam boiler furnace grate, supporting the middle ends of the two ranges of fire bars, the other end of the inner bars being supported on the *bridge casting*, the front bars resting upon the *dead plate*.

Bearing.—1. A support upon which anything rests.

2. The area or length of the sustained piece which rests upon the support or is in contact with it.

3. A support for a revolving shaft or the like; the *bearing* is composed of various parts; the *journal* or *bearings* on the shaft; the *brass box* or *step* in which the journal rotates; the *block*, *pedestal* or *frame* supporting and enclosing the brass; and the *key* or *cap* which secures the whole together by aid of bolts or studs.

Bearing Pile.—In civil engineering, a pile driven as a pillar to bear a superstructure.

Bearing Plates.—Brackets or supports of cast iron or forged steel, employed in heavy timber framing, to afford a bearing surface for the girders, where the latter are attached to the upright members or posts. These attachments are also known as *post caps*.

Bearing-pressure.—In mechanics, the action or force of bearing or resting; as, the pressure of a beam on a wall.

Bearing Spring.—In railway engineering, usually known under the name of *bolster-spring* or *journal-box-spring*. The spring which carries the weight of the vehicle, and rests on the axle box, thus preventing jars and shocks.

Bearing Surface.—1. The area of the surface upon which a shaft rotates.

2. In machinery, the surfaces of bearing parts which are in mutual contact. The larger the total bearing surface the less the amount of friction per unit of surface, since pressure is then distributed over a larger area.

Bearing-Wall.—In architecture, the walls on which the floor beams of a structure rest.

Bearskin.—A coarse, shaggy, woollen cloth, mainly used for *overcoats*.

Beater Press.—One in which the cotton bale is made by beating it into smaller bulk; or as is more usual, in which the bale is packed by beating, and finally solidified, by direct and maintained pressure.

Beating.—In steam engineering, a term applied to the regular thudding sound produced by the engines of a locomotive or a steam vessel.

Beating Engine.—In paper making, a machine similar to the breaking engine except that its knives or bars are blunter and are set in groups of two's instead of three's. In it the half-stuff is finally worked up into pulp.

Beaumé's Hydrometer.—Two different instruments are known by this name, one for liquids heavier than water, and the other, more generally used, for those liquids lighter than water. In the first, the hydrometer floats at 0° in pure water, and the stem is usually graduated up to 66° which equals the specific gravity of sulphuric acid. With the second, the stem shows 10° in pure water, and is graduated up to 90°. To avoid long stems, instruments of both types are made to cover only a small range of degrees, one hydrometer being employed for use from 10° to 40°, and another to show from 40° to 70°.

Beaumontique.—In founding, a moulder's term for a *cement* made of iron filings with sulphur and sal ammoniac; used to stop small holes in castings.

Becket.—1. A rope grommet used as a handle for lifting articles.

2. A wooden cleat or hook for securing lines.

3. A loop or cleat of any material through which a fastening may be passed.

4. A short length of line with an eye at one end and a knot at the other to secure articles temporarily together, such as the oars, boat-hook and mast of a row-boat.

5. A loop at the lower end of a wooden block, to which the standing part of the fall is made fast.

Bed.—1. That upon which something lies or is laid.

2. Some part or surface which serves as a foundation or support.

3. In masonry, the layer of mortar or cement spread upon one course of stones or brick for the reception of the next course, to bind them together.

4. The ground or bottom containing a body of water, as the *bed* of a lake or river.

5. Anything resembling a bed in appearance, especially a mineral deposit having sedimentary characteristics and lying more or less flat, as distinguished from a true vein or lode.

Bedding Brasses.—The operation of adjusting the journals of a shaft and its bearings to each other. After the machine work has been completed as accurately as possible, the shaft is smeared with red marking, placed in its bearings and rotated; when taken apart the points in contact have turned from red to black, and these high places are reduced with scrapers until after repeated trials, both surfaces present a uniformly black appearance after marking.

Bedding-in.—In a foundry, the simplest method of moulding, in which the pattern instead of being rammed on each side in a jointed box and rolled over, is laid or embedded in the sand of the foundry floor. The sand is then tuckered in and rammed around and over the pattern.

Bedding Machine.—A variety of slot drilling machine, with a gang of five drills, used to form the bed or hollow for the lock mechanism in a gunstock.

Bedding Stone.—In masonry, a flat slab on which to test the accuracy of the face of a brick. The device is only used on *front work* or fancy brick work.

Bede.—In mining, a miner's pick-axe, distinguished from the regular or so called *contractor's pick-axe*, on account of its shortness of blade and pick, which enables a miner to work in small spaces and corners.

Bed-knives.—In paper-making, the fixed knives below the rolls in breaking and beating engines.

Bed-lathe.—The usual form of lathe, in which the *puppets* and rest are supported upon two parallel and horizontal beams or shears; as, in a *turner's lathe*.

Bed-moulding.—In architecture, the moulding of a cornice immediately below the *corona*.

Bed-plate.—In machinery, the foundation plate to which the frame of a machine is bolted; as, of a steam engine. It is usually of cast iron with suitable projections to which the different parts of the machine or engine are bolted, called also, *base-plate* and *sole-plate*.

Bed-rock.—In civil engineering, the solid rock underlying superficial formations, such as gravel, sand, etc.

Bed-site.—In architecture, in designing of small country cottages or *bungalows*, a recess in a room distinguished from an alcove by being small and only able to contain a bedstead and opening, having no arch or ornamental work.

Bed-stone.—In flour milling, the term applied to the lower or stationary millstone. The lower stone, however, in some mills is the runner. In some mills again, the stones are driven in contrary directions. The term *bed-stone*, in such cases loses its significance, and it becomes the runner or the lower runner respectively.

Beech.—A beautiful forest tree with smooth silvery bark. It is heavy, hard, very strong, tough, of color ranging from white to reddish. Is used for turnery, tool handles, drawer and door knobs, wooden screws and nuts, mortise wheel cogs, printers' woodwork, etc. On the European continent, beechwood is burnt into charcoal. Its nuts or *mast* are fed to poultry, pigs, etc. and are pressed for oil.

Beeswax.—The wax secreted by the glands of the honey-bee, and used by that insect to form the cellular walls of the honey comb; it is regarded as the type of a true wax, consisting of an *ester* and a free fatty acid. Beeswax has a specific gravity of .962, and melts at from 144° to 149° F. It is largely used in various arts and manufactures; for polishing furniture, floors, etc.; in candle-making, shoemaking, etc.

Beetle.—1. A heavy wooden mallet, used for a variety of purposes, especially in dealing with textile fibers.

2. A heavy cylindrical or bottle-shaped piece of wood with handles projecting from the sides, wielded by one or more men; used for driving small piles, setting paving blocks, etc.

Beet-root.—In sugar making, a product of which the sugar is made; the main material of a large industry, which by its requirements for special machines gives employment to many mechanics.

Beet-sugar.—This is made from the root of the beet by first washing the roots in a rotating drum submerged in water, then rasping them to a pulp and pressing out all the saccharine juice. This juice is heated to 140°, clarified by hydrate of lime, and finally filtered and evaporated in a vacuum pan.

Begin.—To do the first act or the first part of an action; to enter upon or commence something new; as, a new form or state of being, or course of action; to take the first step; to *start*.

Behind.—1. At the back part; in the rear.
2. Backward in time or order of succession; past.

3. After the departure of another; as, to stay *behind*.

Belay.—1. To lay or cover on; to adorn.

2. In navigation, to *make fast*; as, with a rope, by taking several turns with it round a pin, cleat, or kevel.

Belaying Pin.—A peg or pin, fitted into a rack, around the mast, or along the bulwarks of a ship, upon which a sheet or halyard is secured by winding in a crisscross manner, or *belaying*.

Belfry.—In architecture, a bell-tower, generally attached to a church or other building, but sometimes standing alone.

Bell.—1. A hollow metallic vessel, usually shaped somewhat like a cup with a flaring mouth, containing a clapper or tongue, and giving forth a ringing sound on being struck.

2. In the U. S. and Canada, the locomotive has legally to be provided with a bell, which is rung on passing through stations or level road crossings, or moving about the railroad yards.

3. Anything with expanding outlines resembling in form a bell.

4. In plumbing, the expanded female portion of a wiped joint.

5. In pipe fitting, the recessed or enlarged female end of a cast iron pipe, into which the male end of the next pipe fits, also called *hub*.

6. The conical cover of a blast furnace, collecting the gases for use in regenerative stores, etc., but swinging to admit the *charges*.

Bell and Spigot Joint.—The customary method of jointing cast-iron gas or water pipes. Spun yarn is first stemmed into the bottom of the annulus formed by the *spigot* of one length and the *bell* of the next. A mould of fire-clay is placed over the end of the pipe and the remainder of the groove poured full of molten lead. When cool, the fireclay is removed and the lead caulked around the joint, beginning at the bottom.

Bell Arch.—In architecture, an arch of unusual form; as, of a bell.

Bell-buoy.—A buoy on which hangs a bell, which is rung by the surge of the waves, to give warning of danger.

Bell-center Punch.—A shop tool for quickly locating the centers of small shafts of varying sizes. It consists of a flaring bell, with a punch working in a central hole; the bell fits itself to any shaft end within

the limits of its extreme diameters and the punch finds the center accurately, a blow on its projecting end making the desired mark.

Bell Chuck.—A bell-shaped form of lathe-chuck, within which the work is held by adjustable set-screws alone. Used for small work or for driving the ends of shafts, etc.

Bell Cord.—A signaling line formerly running the whole length of a railway train, connected with a bell on each coach and on the engine, to communicate with the engineer and give him instructions to stop or start. The name still survives in connection with the air brake signal. Also called *communication cord*.

Bell Crank.—A triangular frame oscillating about one angle as pivot, used to convert horizontal reciprocal motion into vertical, or vice versa; as, in the air pumps of some large horizontal engines. The bell crank often consists simply of two levers at right angles, keyed on the same shaft.

Belleville Boiler.—A water-tube boiler, with tubes about three and a half inches in diameter, arranged in a zigzag manner without headers, so that each element consists of a continuous coil, from the mud-drum to the steam drum. A smaller edition of the boiler, termed the *economizer*, is arranged above the combustion chamber; in this the feed-water is heated. In the English Navy, each Belleville boiler consists of eight elements or stacks, each of which comprises fourteen tubes. The feed water is regulated by a float which controls the pumps.

Bell-glass.—A glass vessel having the shape of a bell, used to cover plants or other objects which require protection.

Bell-hanger.—One who fixes wire-moved bells in residences, etc. Also extended to cover the fitting of electric or pneumatic bells.

Bell Metal.—A bronze containing about 80% copper and 20% tin, zinc being added for large church bells, while chimes are cast from 87½% copper and 12½% tin.

Bell-mouthed.—A shop term, used to signify the open end of a vessel or pipe when it expands or spreads out with an increasing diameter thus resembling a bell. Also called *trumpet-mouthed*.

Bellows.—An instrument for producing a current of air; in its simple forms consisting of two boards, between which a flexible air-chest is alternately expanded and contracted, drawing in air through a non-return valve on its extension stroke, and expelling it through a nozzle when compressed.

Bell-ringer.—An appliance worked by steam or compressed air, which rings the locomotive bell as long as desired.

Bell-roof.—In architecture, a roof shaped according to the general lines of a bell.

Bells.—At sea, the time is denoted by strokes on the ship's bell, the beats being made in pairs with an interval of about one second between each pair. An extra stroke is given for each half hour through every watch, thus ranging from 1 to 8 bells which is struck at the change of the watch. In the dog-watches, 4 bells are struck at 6 p. m. and 1 bell at 6 20, 2 and 3 being struck at the proper times and 8 bells at 8 p. m. As a warning, one bell is usually struck at 15 minutes before 8 bells on each watch; in cargo steamers, etc., 7 bells in the forenoon watch is struck at 11:20 a. m. to give the relieving watch time to get their dinner.

Belly.—In mechanics, the front or lower surface of an object; as,

1. In railway engineering, the belly of a railroad rail; a descending flange between bearings.

2. In wheelwrighting, the wooden covering of an iron axle.

3. In architecture, the batter of a wall.

4. In shipbuilding, the hollow of a compass timber; the convexity of the same in the back.

5. In machinery, a swell on the bottom surface of anything; as, a depending rib beneath a grade-bar, iron beam or girder to strengthen it from a downward turn between supports.

6. In locksmithing, the lower edge of a tumbler against which the *bit* of the key plays.

Belly-brace.—In steam engineering, a cross-brace stayed to the boiler, between the frames of a locomotive.

Belly-rail.—In civil engineering, a railroad rail with a fin or web descending between the portions which rest on the tie.

Belong.—To be a part of, or connected with, to be appendant or related; to owe allegiance or service.

Below.—Under, or lower in place, beneath; not so high; as, *below* the roof, *below* the waterline.

Belt.—A band of leather or other flexible substance, passing around two wheels, communicating motion from one to the other. Belts can be made of any flexible material, cloth, rubber, leather, and can be run in any way, at any angle, of any length, and any speed. The working adhesion of a belt to the pulley will be in proportion both to the number of square inches of belt contact with the surface of the smaller pulley, and also to the arc of the circumference of the pulley embraced by the belt. This adhesion forms the basis of correct calculation in ascertaining the width of belt necessary to transmit a given horse-power.

Belt Clamp.—A device consisting of a *stretching frame*, the two ends of which are coupled by screwed bars; used for pulling the two ends of a belt together with the proper tension, when lacing or joining the ends.

Belt Compressor.—An air compressor actuated by means of a *belt and pulleys* from shafting or an independent engine.

Belt Conveyor.—An appliance for transporting materials such as grain, ore, etc., consisting of a traveling endless belt of cotton or india rubber belting, provided with pockets or buckets to receive the material conveyed.

Belt-course.—In building, a course of ornamental or moulded bricks projecting from the walls of a building; a band or *string-course*.

Belt Dressing.—A paste applied as a preservative to leather driving-belts, rendering them soft and pliable, thus securing better adhesion and improved driving power. The best compounds are a mixture of fish and animal oils, say cod liver oil and tallow, melted together and incorporated while warm, cooling to an ointment. This is worked into both sides of the belt with a square brush, such as is used for polishing shoes. Boiled linseed oil is said to be the best dressing for cotton belting.

Belt Fastener.—A device or contrivance for uniting the ends of belting, many diverse types being used as a substitute for leather laces. *Belt hooks* are curved pieces of brass or copper wire, with each end hooked towards the middle; the fastener is placed inside the belt, a hook passed through either end of the latter, and the points of the hooks flattened down on the outside, to secure the joint. *Belt studs* are made of brass and resemble the letter I. The two belt-ends are opposed to each other and slitted, back to back by a special cutter; the stud is inserted edge-wise through both pieces, turned half around when in place, thus completing the fastening. Other fasteners consist of metallic plates furnished with numerous vertical teeth, these are driven through the belt and clinched over, the plate forming a sort of butt strap.

Belt-knife Splitter.—A machine for splitting hides into thin leathers as for boot uppers, the splitting being effected by a razor edged blade working like a band saw over pulleys.

Belt Lacing.—Thongs of soft oil-tanned leather used to fasten driving belts, being threaded from hole to hole in either end of the same.

Belt Pulley.—A wheel that drives, or is driven by a belt.

Belt Punch.—A cutting tool whose edge is formed as an annulus or tube; used to cut circular or oval holes in leather or other materials, especially *driving-belts*.

Belt Screws.—In millwrighting, male and female screws used for uniting the overlapped joints of belts.

Belt Shifter.—In machinery, a device for shifting a belt from a fast to a loose pulley or *vice versa*, to cause a change in the motion of the belt, or to shift the power of the belt to another pulley running in the same direction.

Belt-shipper.—In machinist work, usually a length of round bar iron or of gas tubing held from below, by which an overhead belt is slipped over its pulley.

Belt Speeder.—A pair of cone pulleys, carrying a belt which, by *shifting*, becomes the medium of transmitting varying rates of motion. It is much used in some spinning machines to vary the rate of rotation of the spool as the *cap* increases in size.

Belt Stretcher.—In millwrighting, a mechanism employed to stretch new leather belting. But belts are stretched very commonly by being suspended in a loop from above and loaded with weights. All new belts must be stretched before using, otherwise they will soon have to be taken up, shortened and relaced.

Belt-tension.—The ultimate strength of leather belts varies from 3,000 to 5,000 lbs. per square inch. But at the laced joints the strength is only thirty per cent. of those values, or from 900 to 1500 lbs. per square inch. The *working tension* should not exceed about 300 lbs. a square inch. A good rule is 20 lbs. per inch of width for each $\frac{1}{8}$ inch in thickness of the belt. The tensile strain is found by multiplying the number of the H. P. to be transmitted by 33,000 and dividing the product by the velocity of the rim of the pulley in feet per minute. This represents the strain in pounds upon the driving side independently of the initial tension producing adhesion between the pulley and the belt. This initial tension should be sufficient in amount to prevent slipping on either of the pulleys at the moment of starting.

Belt Tightener.—A device employed to maintain a uniform tension upon driving belts, or to cause them to conform more nearly to the circumference of the pulleys.

Belt Tripper.—A contrivance employed in conjunction with belt or apron *conveyors*, by which the belts are *tilted sideways* at any convenient point to discharge their load.

Bench.—1. A strong and heavy table at which mechanics and others work, as a carpenter's *bench*. Benches are usually constructed in longer or shorter lines with the best light obtainable. A vice and a drawer are put about every ten or twelve feet. In machine shops, the vice-man usually has this place with its appropriate tools and drawers, to which he has the exclusive key.

2. In civil engineering, a platform or terrace about six feet wide on the face of an excavation, which is made in *benches* or steps to attack as much of the work as possible at once.

3. To undercut or hole the coal.

4. A portion of a coal-seam separated from the remainder by a stratum of shale or other mineral.

5. A series of retorts, as arranged for the distillation of illuminating gas from coal. What is known as a *battery* of boilers, etc., is often termed a *bench*.

Bench Hook.—A Z-shaped piece of hard wood fitting upon the edge of the carpenters' work bench, so that the latter may not be marred by occasional sawing or cutting.

Bench Lathe.—A small lathe for jewelers' or pattern makers' use which is mounted upon the work bench instead of standing by itself.

Bench Mark.—A permanent reference mark placed upon a stone pillar or similar object, thus $\overline{\text{A}}$, to serve as a reference point in making surveys. So called because the horizontal cut serves as a *bench* or support for an angle iron attached to the staff when taking a reading from the mark.

Bench Rammer.—A moulder's tool, made of wood with brass faces, used in pairs to ram or compress the sand in small moulds made at a bench.

Bench Screw.—A screw and clamp, both usually of beechwood, employed by joiners and pattern makers to secure work to the side of the bench.

Bench Stop.—A latch or step, fitting in a notch in a carpenters' work bench, to serve as an abutment for pieces when undergoing planing. The stop is tapped up or down in its place according to the thickness of material operated upon.

Bend.—1. A curved length of pipe, struck to a larger radius than an elbow, generally five times the pipe diameter.

2. A turn or curve in a conduit or duct.
3. To fasten; as, one rope to another, or to secure one thing to another by means of ropes or cordage.

Bending-moment.—In mechanics, tendency or measure of tendency to produce *bending*.

Bending stress.—In physics, a force acting upon some member of a structure tending to deform it by bending or flexure; the effect of this force causes bending *strain* on the fibers or molecules of the material of which the part is composed. An instance of pure bending stress is given by pulling on the end of a lever, which tends to deflect it while performing work.

Bends.—A name given to a disease which is contracted by working in compressed air. The person who is suffering from this disease will bend together and frequently will be crippled for life, hence the name.

Beneath.—In a lower place; underneath; lower in place, with something directly over; under.

Bent Crank.—A crank shaft bent to shape from a round or oval bar, usually in dies, under a steam hammer or hydraulic press. The advantage of such cranks is that the line of fibers remains continuous and unbroken from one end to the other, whereas they are interrupted sharply at right angles in a slab-crank forged and then machined from the solid. Pumps and agricultural machines frequently have bent cranks with three, four or even six throws in one piece.

Bent Gouge.—In wood working, a gouge bent towards the *basil*, and used for scooping or hollowing out concave surfaces.

Bent Wood.—Household furniture made from wood which has been steamed and pressed into curved forms, thus securing a light and graceful appearance.

Benzene.—In chemistry, a volatile, very inflammable liquid, contained in the naphtha produced by the destructive distillation of coal, from which it is separated by fractional distillation. The name is sometimes applied to the impure commercial product of *benzole*, and also, but rarely to a similar mixed product of petroleum.

Benzine.—A commercial or trade name given to various light volatile hydrocarbons distilled from petroleum. General refinery usage applies the term to all distillates between petroleum ether and the illuminating oils; corresponding to commercial *gasoline*. Other authorities so designate the fractional petroleum product distilling between

160° and 200° Fahr. Benzine is a valuable solvent for organic substances, such as fats, india-rubber, and the like. The various aromatic bodies may be regarded as derivatives of the *hydrocarbon benzine*.

Benzoic Acid.—A shining white crystalline solid forming light feathery needles, of characteristic smell, obtained by sublimation of *gum benzoin*, which contains 12 to 20 per cent. of the acid, also from natural or artificial oil of bitter almonds. The acid melts at 248° F., and dissolves in 400 parts of water at 60° F. It is a powerful *antiseptic*, and its salts, especially *sodium benzoate*, are much used in preserving food products, such as pickles, relishes, etc.

Benzoin.—A fragrant resin obtained by incision in the bark of the *styrax benzoin*, a tree found in Malaysia, the best coming from Siam. Gum benzoin is allied to frankincense, with which it is used to compound incense and pastilles. Benzoin is the characteristic ingredient of *friar's balsam*.

Benzole.—A name frequently given to *benzene* to distinguish it from *benzine*, the petroleum product which is entirely dissimilar.

Berm.—1. In civil engineering, a ledge at the foot of an embankment or the slope of a cutting, to catch any material that may roll or slide down.

2. The bank opposite the towing path of a canal.

Berth.—1. In navigation, (a) convenient sea room; (b) a room in which a number of the officers or ship's company mess and reside; (c) the place where a ship lies when she is at anchor, or at a wharf; (d) a place in a ship to sleep in.

2. In railway engineering, a long shelf or compartment in railway cars to sleep in; as, a *berth* in a Pullman sleeper.

3. An allotted place; an appointment; situation or employment.

Bessemer Converter.—In steel making, the vessel employed for the production of mild steel directly from cast-iron, by the patented process of its inventor. The converter is a pear-shaped vessel lined with a refractory material, ganister or magnesite, and provided with tuyeres for the blowing in of air under pressure. It swivels upon trunnions, by means of which it is tilted up and the molten steel poured out when the process is complete. The blowing of air oxidizes the carbon to carbonic oxide. Spiegel-*el*sen is added in sufficient amount to impart the quantity of carbon requisite to make steel of a definite degree of carbonization.

Bessemer Process.—A method of producing mild steel directly from cast-iron. The process is carried on in a *converter*, an

egg-shaped retort, swinging upon trunnions, through which a powerful current of air is blown. The converter is charged with molten iron from the blast furnace while in a horizontal position, and is swung into the vertical as the blast is applied. The silicon floats as slag on the surface and is removed separately; the oxygen of the air burns away other impurities and combines with the carbon. The *spectroscope* is used to watch the mouth of the converter, to notify when the carbon disappears from the spectrum of the flame; when freed from carbon, the converter is swung through a small arc and a measured quantity of *ferro manganese* or *spiegel eisen* added to insure the right percentage of carbon, the blast being once more applied to effect thorough incorporation. Subsequently the converter is lowered horizontally, and emptied into ladles, whence its contents are cast as *ingots*.

Bessemer, Sir Henry.—Born 1813, died 1898. An English engineer and inventor. He early made a large number of valuable inventions in different lines, but it was the beginning of the Crimean war which turned his attention to the work by which he achieved fame. He commenced the study of metallurgy and engaged in experiments to obtain a stronger material for the manufacture of guns; he patented a combination of cast-iron and steel (1855) which was followed by his discovery of a new process of manufacturing steel by subjecting the melted pig-iron to a process of blowing to abstract the carbon. The "converter" was next introduced and in 1861 the "Age of Steel" began. Large steel works were soon erected in England for the manufacture of ordnance and rails. The Bessemer process was introduced in the U. S. by A. L. Holley (1867-70) and the beginning of the great U. S. steel industry was then made.

Bessemer Steel.—In metals, the mild steel produced directly from the pig in the Bessemer converter, and used for boilers, rails, girder work, general smith's work, etc.

Best.—Having good qualities in the highest degrees; kind; desirable; suitable, etc. Most advanced; most correct or complete.

Beton.—A European name for *concrete*, made according to the system of its inventor, M. Coignet.

Better.—Preferable in regard to rank, value, use, fitness, acceptableness, or safety, or in any other respect; greater in amount; more advanced.

Betty.—In tools, a round iron bar flattened to a chisel-like expansion at one end and used for raising heavy weights through a short distance; for pushing cars along a line of rails through a limited distance, and generally for the application of a large leverage for a temporary purpose.

Between.—In the space which separates; betwixt; as, New York is between Boston and Philadelphia.

Between Centers.—In machinist work, the chucking of lathe work between the centers of the headstock and poppet, as distinguished from the attachment of work to face and other chucks.

Bevel.—1. An angle other than a right-angle.

2. A chamber or slope formed by the removal of the arris or corner where two surfaces meet.

3. A tool, somewhat resembling a *try-square*, but having the blade hinged on the stock so that it may be moved and set to any angle in its own plane. Useful for marking off work which has to be cut to any desired angle.

Beveled Washers.—In construction work, washers of cast iron used in framed timber work to receive the pressure of the bolt heads and nuts; when the bolts pass through the timber in an oblique direction *beveled* washers are used.

Bevel Friction Wheels.—Bevel gearing for the transmission of power at angles; the contact friction of suitably prepared surfaces replacing the leverage drive of the *cogs* of the ordinary gearing.

Bevel Gearing.—An arrangement of beveled wheels for the transmission of motion from one shaft to another, almost any angle being included by adaptations of the principle.

Bevel Gear Shaper.—A type of machine tool, for beveling wheels. A pattern tooth guides the motion of the cutting tool on the shaper ram, and each tooth is formed in succession as an exact *replica* of the copy.

Beveling Machine.—A machine used for beveling or tapering the external edges of a book cover, or *case*, in book-binding, or for trimming the corners of an electrotpe for printing.

Bevel Mortise Wheel.—One of a pair of bevel wheels, fitted with inserted wooden teeth to secure a silent drive, etc.

Bevel Ring.—In piping, a ring or washer used for insertion between the flanges of abutting pipes which do not stand parallel with each other. When thin they are made of lead, if thick, of cast iron.

Bevel-sawing Machine.—An adjustable machine designed to saw a bevel-angle or a sloping cut.

Bevel-square.—A square whose blade may be set to any required angle in the stock that holds it.

Bevel Wheel.—A toothed wheel shaped like a conical frustrum, used in pairs to transmit motion between two shafts at an angle to each other. When the wheel faces are inclined 45° to their axes they are known as *mitre wheels*.

Beyond.—1. On the further side of; in the same direction as; and further on or away.

2. Past; out of reach or sphere of; further than; greater than; as, *beyond* one's strength.

Bezel.—A term applied by watchmakers and jewelers to the groove and projecting flange or lip by which the *crystal* of a watch or the stone of a jewel is retained in its setting.

B. H. P.—In steam engineering, an abbreviation of *brake-horse-power*.

Bibcock.—A cock or faucet having a bent-down nozzle; a *bib*.

Bi-carbonate.—A salt or compound of carbonic acid, in which half its replaceable hydrogen is replaced by a metal; thus, replacing half the hydrogen of carbonic acid by potassium, gives *potassium bi-carbonate*.

Bi-carbonate of Lime.—In steam engineering, the principal compound to whose deposition the incrustation of steam boilers and water pipes is due. It is at first held in solution in the water as a bi-carbonate, by the excess of carbonic acid. This excess being driven off by heat, the carbonate of lime remains as a floury or muddy deposit, its precise condition varying with the nature of the salts with which it is usually accompanied. In the presence of heat it hardens and forms an injurious scale.

Bi-chloride of Mercury.—An important salt of mercury, in the form of white needle-like crystals, known as *corrosive sublimate*. It is much used in the arts and manufactures, and is a powerful germicide and antiseptic when used in a solution.

Bi-chromate of Potash.—Properly, *potassium dichromate*, the salt of an unknown acid, with the metal potassium.

It is a red crystalline solid, soluble in water but insoluble in alcohol, and very poisonous. The dichromate is used in analyzing iron, as a reagent in various processes, and in electric primary batteries.

Bicycle.—A light vehicle propelled by its rider, and having two wheels, one behind the other. Also called *cycle*.

Bid.—To make an offer; to propose. Specifically; to offer to pay; or to take; as, a certain price for work to be done under a contract.

Bier.—In weaving, a count of forty threads in the warp or chain of woollen cloth. The number of warp threads is counted by *biers*; the threads are termed *ends*.

Bifurcation.—In mechanics, the act or process of forming into two branches; forking out; one part spreading out into two parts, as a branch of a tree; as, the roof leader placed in the center of the back side of a building, leading the water away from the two corners of the roof.

Big.—Having largeness of size; of much bulk or magnitude; of great size; large.

Bight.—1. A slightly receding bay between two headlands, formed by a long curve in the coast line; also, a small recess in a bay, a bend in a river, a mountain, etc.

2. The curve at the middle of a rope suspended by both ends; more generally, a loop formed by the middle portion of a rope which is held by its ends.

Bilge.—Specifically, that portion of a ship's section where the nearly vertical side plates are rounded off to meet the upward slope of the bottom plating, thus giving a port and starboard bilge; generally speaking, when used in the plural, the word implies the space between the engine-room platform or hold flooring and the bottom of the vessel, or else the waterways on either side of the ballast tanks, all serving as receptacles for the water accumulated through leakage, condensation, etc., this water being discharged overboard by special pumps and piping arrangements.

Bilge-ejector.—An apparatus with an arrangement of coned nozzles, to eject the bilge water by means of a *steam jet*, instead of a pump.

Bilge-injection.—A connection fitted to the circulating pump suction, so that in case of an emergency, bilge water may be pumped through the surface condenser, thus freeing the engine-room from water. By law, the bilge injection valve must be non-return, to prevent flooding the ship by mistake or malice.

Bilge Keel.—In shipbuilding, a longitudinal beam or plate on the bilge of a vessel, for protection from rubbing; or in the case of iron vessels without true keels, to prevent rolling. Used with vessels having flat bottoms and light draft.

Bilge Pipe.—In navigation, the pipes through which bilge water on board ship is removed by means of the bilge pump. They are made of lead.

Bilge Pump.—A pump for freeing the bilges of a ship from water. It is usually made the same size or larger than the feed-pumps, and is generally operated from the pump crosshead. The bilge suction pipes are of lead or cast-iron, their sizes being laid down by regulations. To prevent the pumps choking from pieces of coal, etc., *mud boxes* are fitted to intercept any pieces of solid matter. The bilge pump valves are either plain hinged clacks or else rubber disc valves. In sailing ships the bilge pump is often driven by a wind-mill.

Bilge-streak.—In shipbuilding, one breadth of planks or plates reaching from stem to stern and covering the limbers where the bilge water collects.

Bill.—1. In navigation, the point on the end of the arm of an anchor beyond the *fluke* or palm; the *pee*. It is the first part to penetrate the ground, and is made slightly hooking.

2. In shipbuilding, the end of a compass or knee timber.

3. In mechanics, the point of a hook.

Billboard.—In navigation, a piece of thick plank, armed with iron plates and fixed on the bow or fore channels of a vessel for the bill or *fluke* of the anchor to rest on.

Billet.—A short rectangular bar of mild steel, wrought iron or piled scrap, measuring about 18 inches long by 3 inches square. *Steel billets* are produced for rolling into plates for tinning; others are made for manufacturing small sections of finished iron or steel, or for smith's use.

Billion.—According to the French and American method of numeration, a thousand millions or 1,000,000,000; according to the English numeration a million millions or 1,000,000,000,000.

Bill of Lading.—A written account of goods shipped by any person, signed by the agent of the transportation company

and promising to deliver them safe at the place directed, under conditions stated.

Billy-boy.—In navigation, a bluff-bowed, flat-bottomed barge, with mast hinged to the deck so that it may be lowered in passing under a bridge.

Bimetalism.—The legalized use of two metals, as *gold* and *silver*, in the currency of a country, at a fixed relative value.

Bi-monthly.—Occurring, done, or coming once in two months.

Bin.—A box or inclosed place used as a repository of any commodity; as, a corn bin, an ore-bin, etc.

Binary.—Composed of two; as in the *binary engine*, which utilizes two working fluids, say steam and ether. The exhaust from the steam cylinder passes into a surface condenser, where it condenses and at the same time evaporates the more volatile ether. The ether vapor does work in a second cylinder and is then condensed in a water cooled condenser. The object of the binary engine is to increase the range of temperatures between which a heat engine works.

Binary system.—In refrigeration, a process in which two volatile agents are used, one liquefying at a low pressure and absorbing the other. The chief of these compounds is one of ether and sulphur dioxide, as ether can absorb 300 times its own volume of sulphur dioxide at ordinary temperatures, and has a pressure below that of the atmosphere at 60° F.; as in *Pictet's liquid*.

Binder.—1. Any device or machine that is used in binding.

2. In moulding, cementing materials such as wheat flour, glue, resin, and linseed oil, used to unite the *cores* more firmly.

3. A harvesting machine, or *harvester*.

Binder pulley.—In millwrighting, a pulley, the sole function of which is to bind or tighten a belt or cord on its driving and driven pulleys, when owing to extension or shrinkage of the belt or cord, the tension becomes variable in amount. The binder pulley is properly made adjustable.

Binder twine.—A coarse description of string or cord used in harvesting machinery. Ropemakers know this class of twine by the name of *fussell*.

Binding.—The putting of a cover on a book. In the trade, binding is putting on the *sides*; following the operations of folding, gathering, sewing, rounding and edge cutting, and preceding the covering, tooling, lettering and edge gilding.

Binding-joist.—In carpentry, a joist whose ends rest upon the wall plates, and which support the bridging or floor joists above and the ceiling joists below; a binder. The binding-joist is employed to carry common joists when the area of the floor or ceiling is so large that it is thrown into *bays*. With large floors the binding-joists are supported by *girders*.

Binding-rafter.—In carpentry, a longitudinal timber in a roof supporting the rafters at a point between the *comb* and *eave*.

Binding screws.—Small screws to secure loose parts in cleats, sockets and the like, as the screws which fasten wires to the terminals of an electric battery, or which *lock* the adjustments of a microscope or theodolite.

Binding straps.—In machinery, the loops which secure the cutting tool against the face of the tool-box of a planing or shaping machine. The straps are attached to the tool plate and encircle the shank of the tool, which is then pinched by a clamping screw.

Binding wire.—Fine copper or brass wire, about 40 S. W. G., used for wrapping around joints and splices in wire work, and for many other useful purposes.

Bind rail.—In civil engineering, a piece to which the heads of piles are secured by mortising or otherwise, serving to tie several of them together, and as a foundation for the flooring joists or stringers; a *cap*.

Bing.—In mining, a place for receiving ore ready for smelting; the *bing-hole* is the opening through which the ore is thrown.

Bing-ore.—Lead ore in small lumps.

Bink.—In cotton manufacture, a stock or store of bales piled upon one another, so that the supply of material is raked off from the *side* of the stack, thus averaging and mixing the whole.

Binnacle.—A standard or box in which a ship's compass is fixed, so that it may be conveniently consulted. On well equipped vessels there are at least two binnacles, one for the *steering compass*, the other for the *standard compass*. In the fore and aft line of the ship is the *Flinders bar* of soft iron, to counteract the attraction of the funnel, etc., being placed on the opposite side to the latter. *Compensating magnets* or globes of soft wrought iron,

are placed on either side, port and starboard, to counteract the quadrantal error, due to the earth's magnetization of the ship; *permanent magnets* are placed within the binnacle to compensate for the *semi-circular* error, or that due to the ship being of steel or iron. Other compensating magnets are placed around the binnacle, under lead plates, being set by the *compass adjuster* when swinging the ship.

Binoculars.—A double spy-glass for using both eyes. A *binocular microscope* is one with an eye-piece or tube for each eye.

Binomial.—1. In algebra, of or pertaining to, or constituting, an expression of two terms.

2. Consisting of two names.

Bioscope.—A double vision instrument by means of which the light and reversed sides of a double photograph are alternately illuminated, thus producing an effect in such a way that the two images when viewed by transmitted light, accurately coincide.

Biquadratic.—In mathematics, of or pertaining to the fourth power, or the square of a square.

Birch.—A tree whose twigs are used in making brooms, hoops, crates, etc. and in smoking provisions. The oil derived from the buds and twigs is said to give its characteristic smell to Russia leather, and both twigs and bark are employed in tanning, the latter having many other uses. Birch wood is of fine grain, fairly strong, yellowish white to brown in color.

Birdlime.—A viscous substance, used for snaring birds, prepared from the inner bark of the holly, etc. Its exact constituents and composition are unknown, but it contains 6 per cent. *caoutchouc*.

Bird's Mouth Weld.—A double scarf weld, especially employed when welding iron and steel together. The iron bar is opened out like a V, and the steel is drawn out to a taper to fit therein, thus insuring a double weld.

Birmingham Wire Gauge.—Formerly the English standard for wire and sheet metals, but now employed for the latter only. Its numbers run from 0000 to 86, the former equalling 0.454 inch and the latter 0.004 inch. The B. W. G. is now replaced as a standard in Great Britain by the *Imperial Wire Gauge*, legalized in 1884.

Birr.—1. To make or move with a whirling noise, as of wheels in motion.

2. A rush or impetus; force.

Biscuit.—In pottery, articles of clay molded and baked in an oven, preparatory to glazing and burning. In the *biscuit* form, pottery is porous, but the glaze sinks into the pores and fuses in the kiln, forming a glass-like coating to the ware. Biscuit by its derivation means *twice baked*; but the name as applied to pottery is derived from the similarity which the ware in this stage bears to the edible biscuit. It is a favorite material for statuettes and ornaments, owing to its soft tone and creamy unglaring face.

Biscuit Kiln.—In pottery, a furnace for baking articles of clay in the biscuit condition, also called *glaze-kiln*.

Bisect.—To divide into two parts, especially two parts of equal size; as, to bisect an angle.

Bisecting Dividers.—Proportional dividers whose legs are permanently pivoted at one-third of their length from the shorter end, so that the distance between the two points at that end, when the dividers are opened, is just one half that measured by the longer legs.

Bisecting Scale.—In instruments, a flat scale fully and symmetrically divided on each side of its center line. It is usually graduated for $\frac{1}{4}$ inch, $\frac{1}{2}$ inch and 1 inch scales.

Bismuth.—A very brittle crystalline metal, of a grayish white color tinged with pink or red. The native metal is its most important source, as found in Cornwall, Saxony, Norway, etc., but bismuth is often found in combination with ores of silver, cobalt, zinc and lead. Its specific gravity is from 9.6 to 9.8, the melting point is 577° F. and it volatilizes at a white heat. It is a remarkable metal for two properties; its specific gravity decreases under pressure, and it expands on cooling. Various compounds of bismuth with other metals melt at points below that of boiling water. *Wood's metal*, of 4 bismuth, 2 lead, 1 tin, 1 cadmium (all by weight) melts and remains fluid at 142° Fahr. Bismuth is used for a variety of purposes; in making high refractive glass, in lustrous porcelain, in medicine, and as a cosmetic. It is used in many alloys under the name of *expansion metal*.

Bisque.—In pottery, porcelain, etc., the baked ceramic or fine clay articles, which are afterwards glazed and burned to form porcelain.

Bister.—A brown pigment or paint prepared from the root of beechwood.

Bisulphide of Carbon.—A colorless, mobile, very volatile liquid, with a fetid odor. It is heavier than water, very inflammable, and a violent poison. It is used for many technical purposes as it is a solvent of sulphur, phosphorus, fats, resins, and india-rubber. It is employed in making rubber cement, etc.

Bit.—1 In wood working, a boring tool used by attachment to a brace, whereby it is rotated. An auger has many points of resemblance to a bit, but has a cross handle whereby it is rotated, whereas the bit is stocked in the socket of a *brace* and is rotated thereby.

2. In locksmithing, the part of a key which enters the lock and acts upon the bolt and tumblers.

3. In carpentry, the cutting iron of a plane.

4. In metal working, a boring tool for metal; as, *half round bit*, *rose bit*, etc.

5. In tinsmithing, the copper piece of a soldering tool riveted to an iron tang called a *copper bit*.

Bi-tangent.—In drawing, possessing the property of touching at two points; a line that touches a curve at two points.

Bite.—1. The hold which the short end of a lever has upon the thing to be lifted or the hold which one part of a machine has upon another.

2. In rigging a *round turn* with a rope while holding it from slipping.

Biting-in.—In etching, the process of corroding or eating into metallic plates by means of an acid.

Bit-stock.—The handle or brace used to turn a boring bit.

Bitter.—Having a peculiar acrid, biting taste like that of wormwood or an infusion of hops; causing pain or smart.

Bittern.—In salt making, the brine which remains in salt works after the salt is concreted. It has a bitter taste from the chloride of magnesium which it contains—hence its name.

Bitts.—Double posts of wood or iron to which ropes are made fast. A single post is a *bollard*.

Bitumastic-solution.—A compound, largely of bitumen or asphalt. In ship building, it is used as a paint for a preservative inside ship's bunkers, tanks, etc.; in building construction, as a damp-proof coating on the interior walls of cold storage houses.

Bitumen.—1. A mineral pitch or *asphalt*; the residue of forms of petroliferous deposits, whose more volatile constituents have evaporated by the processes of nature.

2. A pigment or paint resembling sepia, made by grinding asphalt with a drying oil.

Bituminous Coal.—That containing from 10 to 20 per cent of hydrocarbons; yielding pitch or tar when distilled and caking to a pitchy or bituminous mass during combustion.

Bituminous Paint.—In hydraulics, a protective coating used for pipes and structures which are laid under water. It is variously made, but is composed essentially of the bituminous products of coal mixed with mineral oils. "Mix immediately and apply hot" is the rule for its use.

B. L.—An abbreviation of *Bill of Lading*.

Blabber.—A shop term for a tattler; a telltale; speaking without any sense or meaning.

Black.—1. Destitute of light, or incapable of reflecting it; of the color of soot or coal; of the darkness, or of a very dark color; the opposite of *white*.

2. In founding, parts are said to be black when they are left just as they come from the foundry or forge, the rough surface being painted instead of polished.

Black-Ash.—The trade name for *crude carbonate of soda*.

Black board.—A diagram board used in schools, lecture rooms and work shops for public demonstration of problems and notices, the exhibition of examples, etc.

Black Copper.—Metal, which, not being of sufficient purity, or containing only about 60 parts of copper to the 100, is subjected to the processes of recalcining and re-smelting. Black copper as it is then called, contains from 70 to 80 per cent of copper.

Blackening.—In *founding*, (1) coal or powdered charcoal dust mixed with the sand. More properly oak charcoal dust, powdered coal or graphite dusted over the surfaces of the mould, after a preparatory dusting with meal or flour which forms a pasty surface on the damp mould, causing the blackening to adhere. Blackening ignites into flame on pouring, thus forming a film of gas between the metal and the sand, obviating fusion of the latter and ensuring a smooth clean casting.

2. Graphite dusted over moulds especially of plaster, to make the casting "peel" easily. Also known as *Blacking*.

Blackening of screws.—In machinery, small set screws in model and other work are often blackened to protect them from rust; they are heated to a black heat and dipped in a bath of oil.

Black flap.—In carpentry, the leaf of a window shutter which folds inside the casing, and is concealed when closed.

Blacking.—A composition for preserving and polishing leather, either in a pasty or liquid form. It generally consists of ivory or lamp-black mixed with gelatine or gum arabic, sperm oil or beeswax being also added. The liquids are mixed with molasses, the pastes with vinegar.

Blackening-bag.—In a foundry, a porous muslin calico bag containing foundry blacking which is designed to be dusted over the faces of the moulds.

Blackening mill.—In a foundry, a large revolving closed cylinder, containing heavy rollers rotating freely upon its internal diameter, by whose crushing action small coal or coke is ground into blacking for foundry use. Instead of cylindrical rollers some blacking mills are furnished with ordinary spherical balls revolving in a corresponding annular groove.

Black-jack.—A miners' term for *zinc-blende*.

Blacklead.—A colloquial term for *plumbago* or *graphite*, which actually contains no lead.

Black nuts.—In machinery, nuts which are not polished but left rough as forged. They are used for common and out door work and for those portions of machine work which are concealed.

Black oils.—In lubrication, crude mineral oils of good body which have been subjected to one series of purification only, to remove their mechanical impurities and volatile oils, but which have not been filtered to improve the color. They are used for cylinder lubrication.

Black pin.—In machinery, a stud or pin which is not turned but left black from the forge. Black pins are often used in the rougher kinds of work, and particularly in those joints which are simply connections and not pivots.

Black plates.—Plates of thin sheet iron rolled and cut to size, ready to be brightened for the tinning process in the manufacture of tin plates.

Black Printing.—A photographic copying process which reproduces a tracing in black lines upon a white ground.

Black Red-Heat.—In blacksmithing, that temperature of wrought iron or steel in which the red color is just visible by daylight. It may be roughly taken as corresponding with 1,000 degrees Fahr.

Black Salter.—One who makes crude potash or *black salts*.

Black Salts.—Crude potash, an unrefined *potassium carbonate* obtained by leaching wood ashes.

Black Sand.—In moulding, the old foundry sand forming the floor of the moulding shop, which is used to construct the main part of the various moulds, but does not come into contact with the metal or pattern.

Blacksmith.—A smith who works iron with a forge, and makes iron utensils, horseshoes, etc.

Black Varnish.—In pattern making, ordinary shellac varnish stained by the addition of lamp-black. It is used largely by pattern makers.

Black Wash.—In moulding, a wash composed of clay and powdered charcoal in water, occasionally with molasses or beer, used to give a smooth surface to cores and the surfaces of moulds. Also called *blackening*.

Blackwork.—The work of the blacksmith in contradistinction to bright work of the silversmith.

Bladder.—A receptacle constructed of thin rubber or gold beaters' skin, used to hold gases for laboratory purposes.

Blade.—1. The cutting part of various edge tools.

2. The thin part or arm of a square, bevel, etc.

3. One of the vanes of a turbine, steam or hydraulic.

4. One of the radial oblique arms of a screw-propeller which conveys the thrust of the engines to the water, and by reaction, forces the vessel along.

Blame.—To censure; to express disapprobation of; to find fault with; to reproach.

Blanchard, Thomas.—Born 1788, died 1864. An American mechanic and inventor. He received over 25 patents for his various inventions, among which was a machine for making tacks, lathes for turning gun barrels and gun-stocks, a steam road wagon, and the process of steaming wood for bending.

Blank.—1. In coining, a disc of metal cut out of a sheet and annealed, ready for stamping with the proper impression.

2. In sheet metal working, a disc or plate cut to the right size for stamping, drawing or performing other operations in a press, or for spinning.

3. In engineering, a piece of metal cast, forged or roughly cut to a definite shape preparatory to accurate finishing to size by hand or machine, usually the latter, and of special type.

Blank-Bolts.—In machinery, the rough forgings of the bolts previous to screwing.

Blank End.—In a foundry, the end of a pipe or cylindrical casting which is closed up so that no through passage exists.

Blanket.—1. A preliminary ore dressing process, in which the pulverized stuff is streamed over tables covered with coarse cloth, the heavier particles being caught in the blanket, which is periodically removed, washed out and its contents subjected to amalgamation.

2. A stratified ore deposit, a Colorado term.

Blank Flange.—In pipe fitting, a plate for covering the end of a pipe, thus making this end a so-called *dead-end*; this term is sometimes used to distinguish a pipe flange in which the bolt holes have not been drilled, but which is complete otherwise.

Blank Holes.—Rivet holes in boiler, ship, bridge and other plate work which is so very inaccurate that when the plates are placed in position, the holes do not correspond within a distance equal to their own diameters. In such cases the holes have to be redrilled or the work condemned.

Blank or Blind Flange.—A plate to entirely close an orifice, as a pipe opening. Called also *no-thoroughfare*.

Blank Tire.—In railroads, a tire without a flange.

Blare.—In navigation, a paste of hair and tar for calking the seams of boats.

Blast.—1. The exhaust steam from a locomotive or other engine driving a column of air out of a boiler-chimney, thus creating a partial vacuum in the smoke-box, toward which the external air is forced by its own weight, creating an intense draught through the fire.

2. In mining, to break up or loosen rock by means of explosives.

3. A current of air impelled by mechanical means to support combustion in a furnace.

Blast Fan.—In blacksmithing, an air propeller, or blowing fan; a device in which rotating vanes are used to force air into a pipe or compartment, thus creating a draught.

Blast Furnace.—A smelting furnace for the reduction of iron ores to the metallic state as cast or pig iron. It is a tower of masonry cased with iron sixty to one hundred feet high, provided with a very thick firebrick lining, as the furnace, when once "*blown in*" may be in operation for several years before being "*blown out*." The interior resembles a double cone, tapering gently upwards from the *bowher*, or part of larger diameter, and sharply downwards terminating in a short cylindrical portion or *well*, also known as the *heart*.

Blasting.—The process of rending rocks, etc., by means of boring, filling the hole with an explosive, and then firing it off. Improvements appertain to the modes of drilling the holes, the composition of the explosive and the means of igniting.

Blasting Cap.—A detonator, consisting usually of fulminate of mercury in a waterproof metal case, employed to explode dynamite, guncotton, etc., in shot firing, or blasting.

Blasting Powder.—A high explosive powder, packed in rolls wrapped in water-proof paper and known as *dynamite sticks*. There are several manufacturers of which each uses a different formula of mixture, but nitro-glycerine is one of the principal parts of each.

Blast Nozzle.—The taper outlet of the exhaust pipe in a locomotive, which by means of the passing jet of steam, creates a draught through the tubes and firebox. Also called *exhaust nozzle*.

Blast Pipe.—In a locomotive, the exhaust pipe which terminates in a *blast nozzle*.

Blatter.—A shop term used for idly talking to a fellow workman; talking very rapidly without much sense.

Blaze.—1. A stream of gas or vapor emitting light and heat in the process of combustion; a bright flame.

2. Intense, direct light accompanied by heat; as, to seek shelter from the *blaze* of the fire.

3. In civil engineering, a spot made on trees, by chipping off a piece of the bark, usually as a *surveyor's mark*.

Bleacher.—1. One who bleaches or whitens linen and cotton goods.

2. A large vessel in which petroleum or its derivatives are exposed to air and sunlight to lighten the color after being refined in the agitators. Also known as *washers*, as the oils are frequently washed thoroughly with sprays of fresh water to remove solid or coloring matter.

Bleaching.—The art and process whereby articles, principally textile fabrics, are whitened or lightened in color. The effect of the process is to oxidize, by means of chemical reagents, the resinous coloring matter in the material. With manufactured goods the natural tint is deepened by the singeing to which it has been subjected, as well as grease or paste used by the weavers, and dirt accumulated during the process. This necessitates an elaborate process in which the cloths—sewed together in lengths of many miles—pass in the form of loose ropes through milk of lime to saponify the grease, are boiled or *bucked* in keirs, washed repeatedly, passed through acid solutions, re-boiled, and finally *chemicked* or whitened with chloride of lime solution. The fabric is then *finished*.

Bleaching Powder.—Chlorinated lime; the articles to be bleached are first immersed in a solution of the chloride, and then washed in a very dilute sulphuric acid bath.

Bleeder.—1. A small cock or valve to draw off water of condensation from a range of piping.

2. In marine engineering, a by-pass valve from boiler to condenser; especially useful with water tube boilers to save the feed water loss occasioned by the frequent blowing-off of the safety valve.

Bleeding.—In steam engineering, the red streaks of rust which *weep* through the scale, adhering to the insides of boilers, and which reveal the presence of corrosion in the plates underneath.

B. L. E.—An abbreviation for Brotherhood of Locomotive Engineers.

Blemish.—Any mark of deformity or injury, whether physical or moral; anything that diminishes beauty or renders imperfect that which is otherwise well formed.

Blende.—1. A mineral called also by miners, *mock lead*; *false galena* and *black jack*. It is a zinc sulphide, but often contains some iron. Its color is usually yellow, brown or black, and its luster resinous.

2. A general term for some minerals, chiefly *metallic sulphides*, which have a somewhat brilliant but non-metallic luster.

Blender.—A large soft brush used by grainers to *blend* the colors of their work, so that the transition from one shade to another is not abrupt and unnatural.

Blind drift.—In mining, a drift connected with the other workings at one end only; a *cul-de-sac*.

Blind-holes.—Rivet holes which are punched so inaccurately that when the plates are brought together the holes do not coincide within the extent of an entire diameter.

Blind level.—A drainage level in mines; having a shaft at each end and working as an inverted syphon.

Blind lode.—In mining, a lode that does not come to the surface of the ground.

Blind shaft.—A *winze*, or auxiliary shaft between different levels in a mine; a shaft that does not come to the surface.

Blind slat.—An obliquely set slat in a shutter, serving to shed rain and yet admit light. In some cases they are adjustable by means of a bar which is secured by staples to the edges of the slats.

Blink.—A shop term meaning to shine, especially with intermittent light; to twinkle; to flicker; to glimmer; as, a lamp.

Blister.—Any elevation made by the separation of the film or skin, as on plants; or by the swelling of the substances at the surface, as on steel.

Blister Copper.—Fine copper which has been roasted to expel sulphur, and melted, being then cast into slabs preparatory to refining. The gases escaping from the molten copper give it a *blistered* appearance, hence the name; this blister copper is about 96 per cent. pure, and its subsequent refining is done by *electrolysis*.

Blister Steel.—Steel made by the first process in the production of carbon or tool steel, by heating wrought iron in intimate contact with charcoal. Its surface is covered with blisters caused by the formation and bursting of vesicles filled with gaseous carbon.

Blob.—Something blunt and round; a small drop or lump of something viscid or thick; a drop; a bubble; a blister.

Block.—1. A grooved pulley or sheave encased in a frame or shell, constituting the block proper, which is provided with a hook, eye or strap for attaching it to an object; a block is used to change the direction of motion of a running rope, or as a mechanical power to raise a heavy load. Two or more such sheaves are compounded to change the rate of motion or to exert increased force.

2. In typography, a term including wood cuts, or the hardwood on which they are engraved; zincotypes, electro-types, etc.

Block and Tackle.—A term including the block and the rope wove through it, for hoisting or obtaining a purchase.

Block Chain.—A power-transmitting chain, used in automobiles, bicycles, etc., in which each alternate link consists of a *steel block*.

Block-Coal.—In mining, a bituminous coal with well defined horizontal and vertical planes, easily split into large lumps, or *blocks*.

Block Hole.—In mining, a short hole drilled in a mass of ore or rock already broken away from the vein, but which has to be broken still smaller for convenient handling.

Block Ice-making.—A freezing process, where two plates are used, and the ice is allowed to freeze on each side and meet in the middle.

Block-in-Course.—A class of masonry much used on piers, abutments, embankments and retaining walls. The stones are squared and brought to good fair joints, the *faces* only being hammer-dressed. The *courses* are of a single stone in depth, but no attention is paid to uniformity of the courses, any good hard stone being used that works into courses three to ten inches deep, the length of each stone being four or five times its depth.

Blocking.—1. In carpentry, a mode of fastening together angles of woodwork; blocks of wood are glued in the *inside* angle.

2. In boot and shoe making, the process of bending leather for boot fronts to the required shape.

3. In bookbinding, impressing a pattern on a book cover by a plate or association of tools under pressure.

4. In house shoring, blocks of wood used for underpinning; as, for the foot of braces, in shoring up walls, also in blocking up derailed cars and engines.

Blocking-course.—The finishing course of plain stones or brick erected on the upper part of the cornice of a building.

Blocking-down.—The act of fitting sheet-metal into an intricate mould or die by beating on it, with a block of lead interposed between the hammer and the work.

Blocking Girders.—In machinery, the girders which are attached to the underside of the truck frames, both back and front, of the traveling crane. They are made considerably longer than the width of the frames, and are placed in a transverse direction, to prevent overturning of the crane when lifting crossways with a full load, an accident which would happen without the broader base afforded by the girder. The girders are supported upon blocking placed underneath their projecting ends.

Blocking Press.—A press used for stamping designs on ornamented book covers.

Blocking-up.—In erection and construction, a term used to denote the elevating and supporting of masses of machinery or other constructions by means of cranes, jacks, levers and wooden blocking.

Block Joint.—A joint used by plumbers, in which an inserted joint is combined with a wide flange, used for *wiped joints* on heavy vertical pipes.

Block Line.—A wire line passing over a system of pulleys; used in *pole-drilling* to lift heavy weights about the derrick, such as casing, etc.

Block Plane.—A joiner's plane in which the blade is set very obliquely to the stock, so that it may be used for planing across the grain of the wood.

Block Printing.—In calico printing, impressing the design on the fabric by means of blocks, usually of sycamore wood; either singly by hand, or arranged in a machine.

Blocks.—1. The timbers at the bottom of a dry dock, upon which a vessel rests when the waters leave her.

2. Large masses of cast iron, etc., serving as dies, upon which boiler plates and the like, are worked to a desired form.

Block System.—A method of railway working, in which the line is subdivided into short sections or blocks, each of which is protected by signals, so arranged that there shall be only one train in a section at a time.

Block Tin.—Tin as it comes in blocks or ingots from the foundry; usually the second quality, the best being termed *refined*.

Blood.—1. The fluid that flows or circulates in the heart, arteries, veins and capillaries.

2. The juice of anything, especially if red.

Blood Heat.—Heat equal to the temperature of human blood, or about $98\frac{1}{2}^{\circ}$ Fahr.

Bloodstone.—1. A green siliceous stone sprinkled with red jasper, as if with blood; called also *heliotrope*.

2. Hematite; an ore of iron yielding a *blood red powder* or streak.

Bloodwood.—A tree having the wood or sap of the color of blood.

Bloom.—1. In iron manufacture, the ball of spongy, plastic iron produced from the puddling furnace; the same as *ball*.

2. In tanning, a yellow deposit found on the inner side of hides when the process of tanning is completed; consisting of tannate of gelatin, which is formed by the action of the tanning solution on the softer constituents of the hide, also known as *pitching*.

Bloomery.—A place where wrought iron is made by the original methods direct from the ore, without the intermediate stage of pig iron. This is the method which still survives in the less civilized parts of the world. Also spelled *bloomery*.

Blooming Mill.—The roll train and apparatuses which *handle* the shingled ball or bloom, or the puddle bar train; also the heavy rolling mill for shaping the large *ingots* formed in connection with the Bessemer process.

Bloom Steel.—In steel manufacture, that made by the open hearth and other processes and rolled into blooms.

Blossom.—1. In mining, the appearance about an outcropping mineral vein which contains oxidizable ores.

2. The outcrop of a seam of coal which has decomposed shale with it.

Blotter.—An order book; a rough book interleaved with blotting paper, in which are registered all accounts or transactions in the order in which they take place.

Blotting Paper.—An unsized, soft, pliable paper of spongy texture, for absorbing ink from paper without blurring the writing; formerly made of rags, but now of special wood-pulp, etc.

Blow.—In founding, to eject fluid molten metal from the mould when pouring, on account of the venting being insufficient to permit the gases and displaced air to escape quietly.

Blow-down.—In steam engineering, the act of letting water out of the bottom of a boiler for shutting up in freezing weather, or *laying off* the boiler for repairs.

Blower.—1. A foundry blowing-machine, in which two cams, or sets of vanes, whose proper relation to one another is maintained by external gearing, are revolved upon each other within an elliptical casing, after the manner of a rotary pump; volumes of air are thus enclosed between the cams and the casing, and forcibly expelled to form the blast.

2. A fan or other apparatus to maintain a blast of air in connection with a furnace or forge.

3. In locomotives, a ring-jet fixed in the base of the chimney, for creating a draught when raising steam, or when standing idle.

4. In mining, an escaped jet of gas issuing into a working from a seam.

Blower and Spreader.—In manufacturing, a machine for spreading cotton into a lap, the action of beaters and blower being conjoined for the purpose.

Blowhole.—In moulding, a hole or cavity in a casting caused by air or gas being imprisoned in the mould, thus making a troublesome bubble in the metal.

Blowing Cylinders.—In blast furnaces, cylinders employed for pumping the air under pressure into the blast main.

Blowing Engine.—1. A large air-pump or low pressure compressor, for delivering air at various pressures from 5 to 15 pounds per square inch, to a blast furnace. The air-cylinder or *blowing tub* is usually on the same piston rod as its driving cylinder. In many recent plants, a gas engine, utilizing the waste furnace gases as fuel, takes the place of the steam engine. Low-pressure blowing tubs have leather-faced clack valves; high-pressure ones are using *grids* or piston valves operated by eccentrics. The *blowing tub* is generally lubricated with *graphite*.

2. An air pumping engine used in connection with steam boilers to supply extra air to the combustion chambers at a pressure of 10 to 15 lbs.; used to promote combustion.

Blowing Furnace.—In glass-making, the furnace within which the glass, previously made in the *melting furnace*, is reheated for the operation of *blowing*.

Blowing-in.—The operation of bringing a blast furnace into use; noteworthy for the fact that a furnace, when once started, often works continuously for several years.

Blowing-off.—Emitting steam at the waste pipe through the safety valves lifting under excessive pressure.

Blowing Out.—1. Extinguishing; as, the shutting down of a blast furnace.

2. Giving way under pressure, with consequent leakage of contents; as, of a joint in a pipe, a plug in a boiler, etc.

Blowing Through.—In steam engineering, the sending of a jet of steam through the cylinders and valves, to warm the engine before starting.

Blowing-tub.—In glassmaking, a wooden vessel filled with water in which the glass blower puts his blow-pipe when not in use, so as to cool it.

Blowing Tube.—The instrument by which the glass blower, through the force of his lungs—aided by dextrous

manipulation of the tube—is enabled to form vessels, etc., from a lump of *metal* or plastic semi-fluid glass, collected upon the extremity of the tube.

Blown.—In foundry, a casting is said to be blown when it is honey-combed with blow-holes.

Blown In.—Blast furnaces are said to be *blown in* or to be *in blast* when they are in full working order. They remain so except when repairs are needed, or trade is too slack to make them pay. *Blowing-in* is an operation which takes three or four weeks to fully effect.

Blown Out.—Blast furnaces are *blown out* or *out of blast* when they are doing no work, being extinguished either through slackness of trade or need of repairs.

Blow-off.—In steam engineering, a term applied to the act of letting out water and steam of a boiler to carry off accumulated mud and scale. Near the bottom of the boiler is a cock valve, and opening this the force of the steam drives much of the accumulated scale, etc. with the water and steam out of the boiler.

Blow-off Cock.—A name sometimes given to the blow down cock or valve of a steam boiler.

Blow-pipe.—A slender tapering tube terminating in a fine needle opening, generally made of brass and with the small end bent at an angle, its extremity being provided with a platinum tip. It is used in connection with a special lamp, and the air is supplied by the mouth of the operator. It is used for soldering, brazing and in mineralogy.

Blow-through-cock.—1. A faucet for releasing the air contained in a steam chamber when the steam is turned on.

2. A cock for blowing steam into a jet condensing cylinder, to warm it, eject condensed moisture, and create a vacuum preparatory to starting the engine.

Blow-torch.—A plumber's torch or similar apparatus in which a spray of benzine, alcohol, etc. is vaporized and expelled in a long, intensely hot flame under air pressure; used for soldering, brazing, removing old paint, etc.

Blow-up.—In sugar refining, a pan in which the partially refined sugar is melted or dissolved in water, under steam heat.

Blue.—One of the seven colors into which the rays of light divide themselves when refracted through a glass prism; the color of a clear sky, or the color resembling that, whether light or darker; a pigment or paint having such color.

Blue-bath.—In photography, a bath of dilute hydrochloric acid containing eight or nine per cent. of acid in which photo-types are bleached, after having been developed in the prussiate bath and washed in the water tray. It becomes blue through contact with the prussiate of potash. Also called *acid-bath*.

Blue Bricks.—Bricks much used in engineering works; they are very heavy and hard, containing nearly ten per cent. of iron, and extremely durable. The presence of much iron alters the color of clay to a deep red, and this, when fired hard at a high temperature, changes to a very dark blue; only the best clay will stand the necessary heat.

Blue Clay.—A clay, having about one per cent each of ferric oxide and lime, which, on being made into bricks and burnt, assumes a hard glazed surface, impervious to moisture, and consequently much used for sewer lining, etc.

Blue Gas.—Water-gas; so called on account of the blue flame with which it burns when not enriched by *oil gas*.

Blue Heat.—A low heat, noticeable in iron and steel as it cools down from a red or working heat; it is unsafe to hammer or work these metals at this temperature, on account of the distress to the fibers. If anything cannot be bent or flanged at a *red heat*, it should be wrought cold and then annealed.

Blue Light.—A signal light burning with a steady blue color. Blue lights are made of a composition of saltpetre, sulphur, etc. These ingredients are well pulverized and mixed, and a sufficient charge is pressed into a hemispherical cup of seasoned wood, having a handle about 10 inches long. These cups are covered with cartridge paper, pasted over the mouth, and are primed with a quick match. When lighted they are held by the handle until the composition burns out.

Blue Printing.—In architectural and mechanical drawing, a copy in white lines on blue ground of a drawing-plan, tracing, etc., or a positive picture in blue and white from a negative, produced by photographic printing on specially prepared paper.

Blue Stone.—1. In architecture, a grayish blue building stone, greatly used in the eastern U. S. for door and window sills, and lintels, outside stairs and stoops.

2. In chemistry, sulphate of copper, a violet blue crystallized salt, used for calico printing, etc., also called *blue vitriol*.

Bluff.—1. Having a broad, flattened front; as, the bluff bow of a ship.

2. A high steep bank, as by a river or the sea, or beside a ravine or plain; a cliff with a broad face.

Bluing.—1. In metal working, the process of heating steel until it assumes a blue color.

2. In house painting, the process of putting some blue in the kalsomine, to obtain a *pure white* for ceilings.

Blunder.—To make a gross error or mistake; as, to blunder in writing or in any other work; to move in an awkward, clumsy manner; to flounder and stumble.

Blunder buss.—An ancient firearm, used in the time of the Dutch settlers in New York. It was a short gun with a trumpet-like formed barrel, which held a large charge of balls and slugs and intended to be used at close quarters. It may be said that the blunder buss was at one time New York's only defence against the hostile Indians.

Blunging Machine.—A pottery machine in which a central shaft, armed with horizontal knives, rotates within a vertical cylinder. It is used to cut up and amalgamate with water such clays as do not require grinding, thus forming *slip*.

Blunt.—To utter suddenly and unadvisedly; to divulge inconsiderately; to ejaculate.

Blunt File.—A file which is nearly but not quite parallel throughout its length. The term *blunt* relates to the point some times called "blunt pointed" to distinguish it from a *taper file*.

Bluster.—To talk with noisy violence; to swagger; as, a turbulent or boasting person; to act in a noisy, tumultuous way.

B. M.—An abbreviation for board measure.

Board.—1. A sawed piece of wood, broad and thin relatively to its length. A board is over $4\frac{1}{2}$ inches in width, and generally about 1 inch to $1\frac{1}{2}$ inch thick; all sizes up to $2\frac{1}{2}$ inches thick are called *boards*. A *feather-edged board* is thinner on one edge than on the other; good boards should be *listed*, that is, have the sapwood removed from the edges; a board is *wrought*, when it has been planed on the side, *edge-hot*, when planed on the edge; *jointing* consists in lining and edge-planing to bring the boards together correctly.

2. A *paste-board*, or thick paper composed of several thicknesses pasted together. The chief varieties are: *Card-board*, of common paper, with fine quality at the surface; *bristol-board*, of fine quality throughout; *mill-board*, of coarse material with a glossy surface produced by calendering and heavy rolling; *straw-board*, a coarse quality made of straw, as, of rye straw, etc.

Boarding.—1. In carpentry, the act of putting boards on a frame.

2. In the leather industry, the process of rubbing leather with a board to raise the grain after it has been *shaved*, *daubed* and *dried*.

Boarding Gauge.—In carpentry, a graduated scribing tool, used as a measurer of width and distance in weather-boarding the sides of houses.

Board Measure.—In carpentry, all lumber which has not been wrought or moulded, is sold by *board measure*, that is, the stock in each piece is reduced to a unit of a square foot of board one inch thick. This is called board measure and is expressed by the abbreviation B. M. Prices of lumber are usually rated by the thousand feet, so that the expression "twenty-five dollars a thousand" means twenty-five dollars for a thousand square feet of stock one inch thick.

Boards.—In book binding, stout pieces of strong pasteboard or strawboard forming the covers of books. When these are covered with paper only, the book is said to be in *boards*; when the foundation boards are covered with cloth, it is in *cloth boards*; when they are covered with leather or an imitation, the book is *bound*. The name is derived from the thin pieces of wood, or *boards*, formerly used for the purpose.

Boaster.—A short broad chisel used by masons in smoothing the surface of a stone and removing tool marks. It is from two inches to two and a half inches in width, being intermediate between the *inch-tool*, and the *broad-tool*, which are one inch and three and a half inches wide, respectively. A similar tool is used by the bricklayer, and termed a *bolster*.

Boat.—1. A small open vessel propelled by oars, or by sails spread upon removable masts and spars.

2. Any small vessel or watercraft; a colloquial or familiar term for any vessel whatever.

Boat-bridge.—A boat-bridge consists of a track laid on a number of boats anchored parallel in the stream, or moored to ropes or chains which pass from bank to bank.

Boat Cradle.—A device adapted for transporting boats up and down inclined planes, such as are made on canals which have no locks, and are used to move the boats from different levels. It consists of a strongly made wooden crib or cradle, on which the boat rests, supported on two iron wagons running on wheels upon plate rails on the inclined plane, and lowered and raised by means of machinery.

Boat-detaching-hook.—In navigation, one adapted to be suddenly cast loose when a boat lowered from the davits touches the water. It is important that the hooks which engage the eye-bolts, stem and stern, should be instantly and simultaneously disengaged when the boat touches water. This is done by upsetting the hooks, the opening of *sisterhooks*, or the tripping of a trigger.

Boat Hook.—An iron hook and spike, mounted on a pole, whereby a boatman gets a grip on a pier, rope, or other craft when coming alongside, and is also able to push off, when getting away, by using the boat hook.

Boatman's Chair.—In rigging, a device for raising and lowering a man up and down on the mast of a derrick. It consists of a piece of plank, large enough to seat a man, with four holes in it to let a rope of sufficient strength go through and hold it in a level position. It is raised or lowered by means of a tackle fastened on the top of the mast.

Boat-skids.—In navigation, a pair of horizontal timbers for supporting the boats after they are hauled in on the deck of a ship.

Boatswain.—In navigation, an officer who has charge of the boats, sails, rigging, colors, anchors, cables, cordage, etc., of a ship, and who also summons the crew and performs other duties.

Bob.—1. In general construction, the suspended weight of a plumb line.

2. In metal working, a small buff wheel used in polishing the inside of spoons. It is a disk of leather nearly an inch thick, known as *sea-cow* or *bull-neck*. It is perforated, mounted on a spindle, and turned into a nearly spherical form.

3. In steam engineering, a working beam.

Bobbin.—1. In sewing machines, a small spool adapted to receive thread and be applied within a shuttle.

2. In manufacturing, a spool with a head at one or both ends to hold yarn. It serves as a cop in spinning, as a thread holder in shuttles of looms, as a cop in warping machines.

3. In carpentry, the little rounded piece of wood at the end of a string, which is pulled to raise the latch of a door, as used in tool houses and offices on construction works.

Bobbin-and-fly Frame.—A cotton spinning machine which takes the *slivers* from the *drawing machine* and converts it into *roving* or *slubbing*. The sliver passes through drawing rollers, and down through the arm of the *flyer* which revolves around the *bobbin*, giving the thread a slight twist as it winds it and forms the *cop*.

Bobbins.—In plumbing, oval or spherical pieces of hard wood forced through lead pipes, after bending, to bring the bore to its proper size.

Bobsleigh.—A sleigh made up of two short sleighs connected by a reach or coupling. In many cases the reach is turned upward to allow the fore-bob to pass beneath the reach in turning; generally the body or platform is supported on pendent bars and hanging links. This conveyance is used in the timber regions of the United States for *lumbering*.

Bobstay.—A rope or chain to confine the bowsprit of a ship downward, to the stem or *cutwater*.

Bodkin.—1. A kind of needle with a blunt point and large eye, used for drawing tape, ribbon, etc., through a loop or series of loops.

2. A sharp tool, resembling an awl, used by compositors in picking wrong or defective letters from a form of type.

Body.—1. A material thing; any substance possessing *inertia*.

2. The main, central or greater part of an organization, assemblage, mechanism or detail, as distinct from extensions or subdivisions.

3. Something possessing substance, and density; as body of a *color*; also associated with the idea of viscosity, as in *oils*.

4. The superstructure of an automobile; that part which resembles and represents the *body* of an ordinary carriage.

5. Substances possessing plasticity and the property of hardening under the application of heat, suitably combined and prepared for use in the manufacture of *pottery*.

Body Truss.—In mechanics, a stay rod running the length of a railway car to brace it against sagging stresses.

Bog.—Wet and spongy ground sometimes with coarse grass and too soft to support a heavy body on its surface.

Bogie.—A swiveling framework which carries the axle of a pair of locomotive or carriage wheels, and by means of which the main framing is enabled to accommodate itself to curves of short radius. A bogie-truck is a short truck resting on two or more

pairs of wheels and attached, by means of a vertical king-pin, to the frames of an engine or carriage, a truck being pivoted at one or at each end of the engine or carriage. Its use is to enable the engine or carriage to run round sharp curves.

Bogie Engine.—In railway engineering, a locomotive provided with a bogie. In the single bogie engines the leading wheels are the *bogies*, in the double bogie engines the leading and trailing wheels are bogies.

Bog Ore.—In mining, an ore of iron found in boggy or swampy land; a variety of brown iron ore; *limonite*.

Boil.—1. To heat to the boiling point, or so as to cause ebullition, as to *boil* water.

2. To form or separate, by boiling or evaporation; as, to *boil* sugar or salt.

3. To be agitated; or tumultuously moved, as a liquid by the generation and rising of bubbles of steam, or of currents produced by heating it to the boiling point; to be in a state of *ebullition*.

Boiled Oil.—Linseed oil which has been boiled or heated to a temperature of from 410° to 500° Fahr., a small quantity of *litharge*, manganese dioxide, or similar substance being added and incorporated while hot. The process of boiling, together with the additions, increases the power of absorbing and combining with oxygen, thus assisting the quick "drying" of the paint.

Boiler.—1. A vessel in which water is boiled, either for domestic or manufacturing purposes, or in which any material is subjected to the action of boiling water.

2. A vessel in which water is evaporated into steam for the generation of power, for heating purposes, etc. The various types may be classified under two heads; shell boilers, in which the water is contained within more or less cylindrical vessels traversed by tubes, through which the flame and heated gases of combustion pass to impart their heat to the water; tubular or water tube boilers, in which the water is contained within the tubes, the products of combustion circulating around them on courses determined by suitable *baffles*. The shell boiler is self-contained, or else mounted on brickwork, which contains various flue passages, etc.; the water tube boiler is contained within a suitable casing of brickwork or metal, or both. The chief varieties are described under the headings, *Belleville*, *Cornish*, *Lancashire*, *Locomotive*, *Multitubular*, *Return-tube*, *Water-tube*, etc.

3. In paper-making, a kier or vessel in which the rags are boiled with caustic soda preparatory to making them into pulp.

Boiler Alarm.—An apparatus or device for indicating a low stage of water in a steam boiler.

Boiler Cleaner (Mechanical).—A device actuated by compressed air, flowing water or a flexible shaft, to clean the interior and exterior tubular surfaces of steam boilers, also those portions inaccessible to ordinary methods. The cleaner usually consists of a boss or head, fitted with revolving scrapers, or else lightly striking hammers to jar off the scale.

Boiler Compound.—A chemical put into a boiler designed to prevent incrustation.

Boiler Covering.—A non-conducting substance used as a clothing for boilers, to prevent loss of heat by radiation. It should indicate where a leak occurs, and also be made in *sections*, so as to be removable for repairs to the shell of the boiler, and then easily replaced.

Boiler Crown.—The uppermost plate in the shell of a vertical boiler. It is of a hollow descoid shape; flanged around the edges and riveted to the outer shell plates. Sometimes it is of a flat form and stayed. The boiler crown proper is that belonging to the outer shell; the *fire-box crown* is that over the top of the furnace or inner shell.

Boiler Explosion.—The violent and unexpected parting of the structure of a boiler *while under steam pressure*, accompanied by a report akin to that of a large cannon when fired by gunpowder. A common hypothesis is that a portion of plate, weakened by corrosion, gives way at the normal pressure, the escaping water, flashes into steam at about atmospheric pressure, giving up the tremendous energy stored as latent heat, and rending everything into fragments, the action of the steam often resembling that of a rocket.

Boiler Feeder.—An arrangement, usually automatic and self regulating, for supplying a boiler with water. The simple force pump or injector, as worked by the engine or boiler, may or may not have self regulating devices by which a nearly constant water level is maintained, but there are other devices by which the variation in the water-level is controlled.

Boiler Float.—In steam engineering, a float which rises and falls with the changing height of water in a steam boiler, and so turns off or on the *feed water*.

Boiler Furnace.—In steam engineering, one specifically adapted for the heating of a steam-generator. The shapes vary with those of the boilers themselves, the latter being cylindrical, wagon-shaped, vertical, etc.

Boiler Horse-power.—1. A commercial rating based solely upon the heating surface of the boiler, an area of 12 to 15 square feet being taken as the equivalent of one horse-power.

2. A unit of power adopted by the judges at the Philadelphia exhibition in 1876, known as the *Centennial Standard*: it equals the evaporation of 30 lbs. feed water per hour, from a feed temperature of 100° F., to steam of 70 lbs. gauge pressure. This is equivalent to 33,305 B. T. U. per hour, or the evaporation of 34½ lbs. of water at 212°.

Boiler Inspection.—Official examination of the internal and external surfaces, braces, etc., of a boiler, at stated intervals, either by Government Surveyors, or those appointed by Insurance Corporations.

Boiler Insurance.—Insurance against damage to and accidents from the use of steam boilers; as a necessary part of the insurance, the boilers are regularly inspected by the surveyors of the insurance company and thus the advice of experts is secured.

Boiler Maker.—A workman who makes boilers; properly speaking, a man who understands the business of the plates, who shapes, bends, flanges, assembles, and otherwise manipulates the plates, and also that of the *riveter* who fastens them together to form the *shell*.

Boiler Mountings.—A collective name for those attachments to a boiler, necessary for its proper use, including *grates, smoke-boxes, uptakes, damper, funnels, castings* and the like, as well as those parts which are more commonly termed *fittings* by the engine-room staff; namely, the various *cocks, gauges, valves*, etc. The brass mountings are more properly termed *fittings*; in some localities they are designated as *trimmings*.

Boiler Plate.—A term formerly used to denote superior qualities or brands of wrought *iron*, suitable for making into the shells or drums of steam boilers. Lowmoor or *equal quality* is alone used for such parts as require an excessive amount of working in the fire. Steel plates are now used instead, being obtainable in almost any size, thus reducing the number of seams and the consequent amount of riveting. A usual specification for the steel is 60,000 to 72,000 lbs. tensile strength, with an elongation of from 18 to 20 per cent. Steel rivets are generally used, although the practice of some firms is to employ wrought iron rivets in conjunction with softer plates, possessing an ultimate strength of 55,000 to 60,000 lbs. per square inch.

Boiler Pressure, (safe working).—The highest pressure considered safe to carry on a steam boiler consistent with the factor of safety employed in its design.

Boiler Room.—That part of a steam plant allotted to the generators. Also one of the water tight compartments on board a warship or other large steamer in which a group of boilers is isolated; where the compartment is not water tight, the division is usually denominated *stoke hole*, and qualified as *forward*, *aft*, etc.

Boiler Scale.—A hard deposit upon boiler plates caused by the presence of salts in the feed water, (carbonates and sulphates of lime and magnesia for the most part) which are precipitated when the water is heated.

Boiler-scarfer.—In steam engineering, a name given to an implement which loosens the incrustations on boiler flues.

Boiler-seatings.—In steam engineering, that part on which the horizontal boiler rests.

Boiler-shell.—In steam engineering, boiler shells are composed of plates with riveted seams. If steel is used the plates may be placed either lengthwise or crosswise with the circumference; if of iron, the plates should be arranged so that the fiber will extend around the circumference, as iron is stronger in the direction in which it is rolled. The shell in which are inserted the stays and tubes, sustains the internal strain of the pressure of the steam.

Boiler-shop.—That department of a works wherein is carried on the manufacture and repair of steam boilers.

Boiler-smith.—In boiler making, a machine so termed for flanging boiler plates.

Boiler Stays.—A rod, plate or the like firmly joining two parts, as plates or sheets, at an angle to each other, or holding them at a fixed distance. The long through stays within the steam space are denominated *bar-stays*; those screwed through two plates are *screwed-stays* or *stay-bolts*; those flattened out at one end for riveting to a plate, are termed *palm-stays*. A stay is sometimes termed a *brace*. Other types are named *crowfoot brace*, *sliny stay*, etc. Boiler stays are generally specified not to have been welded or worked in the fire. The first condition is universal, an exception to the second being that certain navies and railroads have the screwed ends of their boiler stays jumped up under a hydraulic press, to secure a plus thread.

Boiler Testing.—In steam engineering, there are two ways of testing a steam boiler; in testing by *steam*, the conditions of strain are the same as those under which the boiler is worked. Another method of testing is to pump cold water into the boiler until the desired pressure is reached. The distortions or defects of joints are then noticed; if a boiler leaks under pressure, the leaky joints should be marked and calked when the pressure is off.

Boiler-tube.—In steam engineering, the tubes by which heat from the furnace is diffused through the mass of water in locomotive and other boilers of the smaller class. They are usually arranged longitudinally of the boiler, and are fitted by steam and water tight connections to its heads.

Boiling Point.—The temperature at which liquid begins to boil. The boiling point varies with the pressure and with the nature of the fluid; thus the boiling point of ether is 95° F., of water 212° F. under pressure of one atmosphere.

Boil-over.—In refrigerating, by an ammonia absorption machine, the *syphoning over* of the ammonia from one part of the system to another where it does not belong; it generally takes place from the *generator* into the *absorber* or *condenser*.

Bollard.—1. In navigation, a cast iron pillar used for the mooring of vessels on quay walls.

2. Also the pillars of cast-iron bolted to the bulwark of vessels for the coiling of a rope when paying out or heaving to.

Bolster.—In civil engineering, a part of a bridge which is interposed between the truss and its masonry supports. Also, a portion of an arch centering, which extends transversely between the ribs, and sustains the arch stones during construction.

2. Transverse timbers or trussed beams in the floor of a car or the frame of a locomotive tender, especially near the ends of one supported on two trucks; in that case the bolster supports the seat for the truck.

3. In machine shop practice, the pad or die in the lower part of a punching machine, which supports the material to be punched.

4. A perforated piece of iron, similar to the above, used by smiths when heading bolts or punching holes in work.

5. In chisels, gouges, etc., the boss on the tang which abuts against the end of the handle.

6. A short broad chisel used by bricklayers to cut pieces from bricks in dressing them to shape. Also called *boss er*.

7. In rolling mills, the bearings that fit within the housings in forge and mill rolls and which sustain the rolls.

Bolt.—1. A pin of iron or brass used to fasten or secure something in place, the bolt generally having a screw thread for a nut at one end and a forged head at the other.

2. A sliding catch, as for a door or gate, fitting into a *staple* on the door post.

3. A compact bundle or roll of textile fabric, of various lengths according to the material, being usually 30 yards or upwards. A bolt of canvas is 40 yards long.

4. To sift or bolt the finer particles of flour from the coarser, as in milling.

Bolt Circle.—The pitch circle of bolt holes in *pipe flanges*, etc.

Bolt Cropper.—A portable device for shortening bolts, bars, etc., in which great power is obtained by toggle-joint levers, which actuate the cutter.

Bolt Cutter.—A name occasionally applied to a *screwing machine* for bolts. Also a *bolt cropper*.

Bolt Extractor.—A machine like a *hydraulic jack* and working on the same principle; used to force out coupling-bolts, etc., that may have rusted in place.

Bolt-forcer.—A small hydraulic machine for forcing bolts out of couplings, etc., by pressure of a ram.

Bolt-header.—In machinery, a machine for swaying down the head of a bolt blank to form a head; the form of this depends upon that of the die.

Bolt Heads and Points.—Much used, especially in millwrighting, where a number of bolts of standard diameters but widely varying lengths are necessary. The *heads* have a few inches of shank attached to them, the *points* are short pieces of round bar screwed to receive a nut for some two inches or so at one end. The smith can easily and expeditiously make bolts of any desired length from these, by welding a head and point together, or by welding them to either end of a sufficiently long piece of round bar.

Bolting Cloth.—A fabric woven of silk, linen or hair, employed by millers in the process of *bolting* or *sifting*, in the manufacture of flour and meal.

Bolt Rope.—In navigation, the hemp cordage sewn or piped along the edges of sails to strengthen them.

Bolt Sheet.—In a shop warding, tracings or lists of the various bolts, studs and other fastenings to be used in the manufacture of a machine or engine.

Bolt Tongs.—A type of blacksmith's tongs, with straight fluted lips to hold the shank of a bolt, while the jaws are bent out to clear the head.

Bond.—The method of laying brickwork or masonry so that the work becomes firm and stable, by proper use of *stretchers* and *headers*, and care that a vertical joint is covered by a solid center above or below. *English bond*, consists of alternate courses of stretchers and headers; *Flemish bond* of stretchers and headers laid alternately in the same course, care being taken to break joint with the courses above and below; *stretcher bond* is used for half-brick walls or partitions, a header course of bats or half bricks being laid every few courses of stretchers, the same bond is used on nine and fourteen inch walls in cheap work, but if a substantial job is required there should

be no more than three courses of stretchers for one of headers, and the breaking of joints must be carefully watched.

Bonded Goods.—Goods placed in a bonded warehouse; goods for the duties on which, bonds are given at the custom house.

Bonded Warehouse.—A warehouse in which goods on which the duties are unpaid are stored under bond and in the joint custody of the importer or his agent, and the custom house officers.

Bonding.—The depositing of dutiable or excisable goods in government warehouses, where they remain until duties are paid.

Bonding-stone.—A stone running through a masonry wall from one face to another, to bind it together.

Bond Timber.—A longitudinal timber placed in the wall of a building to tie the brickwork together and support superincumbent weight. A *wall plate* or *lintel* is often understood by the same general term.

Bone.—The substance forming the framework or skeleton of an animal, composed of 67 per cent. inorganic matter to 33 per cent organic. When bones are boiled, the organic substance is converted into *gelatine*: on strongly heating them in air, the inorganic matter is disintegrated into a white powder, or *bone ash*, five-sixths of which is *calcium phosphate*, the other sixth being made up of magnesium phosphate, and the carbonate, oxide and fluoride of calcium. Bones are used in turning and in making cutlery handles, the ash is used in assaying, and the presence of calcium phosphate, makes all bone preparations excellent fertilizers.

Bone Black.—Made by calcining the bones of animals in a closed vessel; used as a filtering medium; as an agent to deprive various syrups of their coloring matter; and as a paint. Also known as *animal charcoal*, and *bone-charcoal*.

Bone Glue.—An inferior kind of glue, derived from the gelatinous matter in bones.

Bone mill.—A machine for grinding bones for fertilizer or for making bone-black. Bone grinding is effected by passing the bones through a series of toothed rollers arranged in pairs, the rollers being toothed or serrated in different degrees of fineness, and *riddlers* are provided for sifting the bones into sizes, and they are then sold as *inch*, *three-quarters*, *half-inch* and *dust*,

Bonnet.—1. A cap put over a pile to prevent splintering or damage when driving.

2. A cover, raised in the middle, as those used to guide and enclose the tail end of a steam-engine valve-spindle, or the drum-shaped covers of a piston-valve-casing.

3. The hood or metallic cover over the motor, etc., in an automobile.

4. The cover over a pump valve-box, or of a slide valve casing.

5. A roof or protection over the top of a cage to shield miners should anything fall down the shaft.

Bonneted Safety valve.—In steam engineering, a safety valve covered with a casing or bonnet enclosing the valve and communicating with a waste pipe, through which the waste steam is conveyed away.

Bonus.—Extra payment for special results or satisfactory services; usually a sum of money paid in addition to a stated compensation by the month, year, etc.

Book.—1. A number of sheets of paper bound together on edge, known as the *binding edge*.

2. A package of gold leaf, consisting of 25 leaves, each $3\frac{1}{4} \times 3$ inches square; they are inserted between leaves of soft paper rubbed with red chalk, to prevent adherence.

Bookbinding.—The book, if previously bound in paper or cloth, is pulled to pieces, or if freshly printed, the sheets are folded, and *colliated*, or arranged in proper order, and then pressed. The next operation is *sewing*, each sheet being fastened by the sewn threads to cords across the back; the ends of these cords are laced into the *boards*. The plain or colored papers are next pasted into the front or back of the book, and the book is once more pressed, back up, and *glued*. After drying, *backing* takes place, the book being compressed between two beveled pieces which cause the back to assume a convex shape, assisted by hammering. The boards are then cut to size, roughnesses and cord ends removed, after which the book is cut on its edges. This operation is performed on the *top edge* or head, the bottom edge or *tail* and the front or *fore-edge*, in the order named, while in presses, various devices being employed to produce the concavity of the fore-edge; marbling or gilding then takes place. A paper back is next pasted on, after which the most crucial operation, that of placing the leather covers takes place; this calls for delicate and careful manipulation. Gold leaf is laid on marks drawn with albumen and corresponding to the letters and lines required and then pressed with hot irons; this is for the back, the sides of the book being impressed before gilding. Superfluous gold is then wiped off, and the book polished with warm irons. A cloth book is similarly treated up to the backing, and then simply pasted into a separate case or cover, held by a piece of muslin to which the cords are pasted.

Bookfolding Machine.—A machine for folding sheets for gathering, sewing and binding, adapted to fold sheets to various dimensions from folio downward. They are also adapted for folding two separate sheets together, pasting the separate pages at the back, or for cutting sheets into a number of pieces and folding them separately. *Insets* also may be cut off, and set in as by hand.

Bookkeeping.—The art of recording transactions in a regular and systematic manner; the art of keeping accounts. The books most commonly used are day-book, cash-book and ledger. Bookkeeping by *single entry*, is the method of keeping books by carrying the record of each transaction to the debit or credit of a single account. Bookkeeping by *double entry*, is the art of keeping accounts by making a separate record of every transaction in both a *debit* and a *credit* account.

Boom.—1. In navigation, a spar for extending the foot of a fore and aft sail. The boom on which a fore and aft sail is stretched, is commonly provided with jaws which partially encircle the mast, and are held to it by a *half grummet* strung with balls of hardwood to avoid friction.

2. In marine fortification, a chain or line of connected spars, stretched across a river or channel to obstruct navigation, or detain a vessel under the fire of a fort.

3. In rigging, a long spar or beam, projecting from the mast of a derrick, from the outer end of which the body to be lifted is suspended.

4. In lumbering, a line of connected floating timbers stretched across a river or enclosing an area of water, to keep saw-logs, etc., from floating away.

Boomerang.—A missile formed of a bent stick with a rounded and a flat side, and used by the Australian natives. Generally it is three feet long, 2 inches wide and three-quarters of an inch thick, and is grasped at one end and thrown sicklewise, either upward into the air or downward, so as to strike the ground at some distance from the thrower. In the first case it flies with a rotary motion, as its shape would indicate, and after ascending to a great height in the air, it suddenly returns in an elliptical orbit to a spot near its starting point. On throwing it downward to the ground it rebounds in a straight line, pursuing a ricochet motion until it strikes the object at which it is thrown. The most singular curve described by it is when it is projected upward at an angle of about 45° when its flight is always backward, and the native who throws it, stands with his back to the object he intends to hit. The boomerang is one of the puzzles of mechanics.

Boomkin.—Sometimes written *bumpkin*; a small spar protruding through the side of a ship.

Boon.—The refuse, stalks, etc., of hemp or flax after the fiber has been extracted.

Boot.—In grain elevators, the bottom part of the leg or vertical conveyor, containing the lower pulley around which the belt works.

Boot Tank.—In millwrighting, a watertight trough fitting into the boot of an elevator under the drum, to exclude moisture, etc.

Borax.—A white or gray crystalline salt with a slight alkaline taste, used as a flux in soldering or welding metals, and in the manufacture of glass and artificial gems. It occurs native in certain mineral springs and is made from the boric acid of hot springs; pyroborate or tetraborate of sodium.

Bord.—In mining, a lateral passage where a shaft intersects a seam of coal.

Border.—1. In milling, the hoop or curb around a bedstone or bedplate, to keep the meal from falling off except at the prescribed gap. Used in gunpowder mills and some forms of grain grinding mills.

2. In locksmithing, the rim of a lock.

3. In textile manufacture, that part of the cloth containing the selvage.

Bore.—1. An interior cylindrical surface; as, of a tube or cannon.

2. The interior diameter of a cylinder.

3. To make or enlarge a hole.

4. A phenomenon attending spring tides in many funnel shaped estuaries, where the rising tide comes up stream like a wall of water; due to the configuration of the land and the direction of the wind.

Bore Dust.—The chips or fragments made in boring.

Bore Hole.—An artesian well, which has been drilled or bored.

Bore Meal.—In mining, the dust forming at the bottom of a drilled hole.

Borer.—A conical or tapering reamer or shell bit with a T-handle, used by coopers to enlarge and finish bungholes in casks.

Boring.—The operation of drilling or making a hole through any material. In mechanical engineering, the term is limited to the reverse of turning, that is, imparting a true cylindrical form to the interior surface of objects. Thus, *boring* presupposes an existing hole which has to be made true and enlarged to the proper size, while *drilling* relates to the formation of holes in solid material.

Boring Bar.—1. A truly turned bar fitted with radial cutters, which is used in the operation of boring large pieces, such as engine cylinders. The bar is mounted in bearings axially true with the cylinder, and is fed through the stationary work as the cut progresses, being driven by a headstock similar to that of a lathe.

2. Sometimes applied to a tool holder used for boring in the lathe, a small cutter of special steel being used instead of the more expensive forged tool.

Boring Head.—In boring machinery, the ring which carries the cutters of a boring bar. It is actuated by a screw sunk in a recess in the bar itself and driven by gearing from one end. A boring head may also be fixed on a mandrel and revolved without end long movement, the work being made to travel by means of a slide-rest against the cutters.

Boring Machine.—A machine tool used in boring cylinders and other large details of machines, the work being clamped on a bed and the tool revolving in fixed supports.

Boring Mill.—A type of machine tool, which is really a vertical lathe, the work revolving on a circular table, while the tool rest is carried by a cross rail like a planer. This tool is advantageous in that heavy pulleys, etc., are more easily chucked than in the ordinary lathe.

Boring Rest.—In machinery, a lathe rest whose outline is that of the letter L, the horizontal arm, which is uppermost, being slotted to take the flat of a boring tool or drill, and so prevent it from turning round. The hinder end of the boring tool is centered on the poppet-mandrel and by it fed along to its work. Such rests are used with ordinary lathes and also with lathes of special construction, called boring lathes, in which the poppet-mandrel is fed forward automatically, through the medium of a back-shaft and gearing.

Boring Stem.—A heavy bar on which the drill bit is mounted in boring artesian wells, serving by its weight to give force to the blow. Usually termed *sinker*.

Boring Tool.—A lathe tool, especially adapted for boring holes in castings, etc.; forged usually with a round stem and its nose turned to the left hand side.

Borough.—An incorporated town or village; or, as in the city of New York, a section of the city incorporated, having partly its own administration, and still forming with other boroughs, a city.

Borrow.—1. In arithmetic, to take one or more from the next higher denomination in order to add it to the next lower; a term of subtraction when the figure of the *subtrahend* is larger than the corresponding one of the *minuend*.

2. In construction of road or bridge work, to excavate earth in other places than in the regular cut and fill to obtain material enough for filling to required level.

Bort.—1. Black diamonds of Brazilian origin, used for the crowns of diamond drills on account of the resistance to crushing and cleavage.

2. Splinters of diamonds, etc., small inferior stones used as grinding material to cut other diamonds and rubies.

Boshes.—The inward-tapering, lower portion of a blast-furnace extending from the widest part or *belly* to the *hearth*.

Bosom.—In a mill-stone the plain surface between the eye and the furrows.

Bosom-piece.—A covering piece for the butt joints of angle bars. A term particularly used in ship building.

Boss.—1. Any protuberant part; a round swelling part of a body; a knoblike process; as, a boss of wood.

2. In masonry, a wooden vessel for the mortar used in tiling or masonry, hung by a hook from the laths, or from the rungs of a ladder.

3. In mechanical engineering, the large part of a shaft, on which a wheel is keyed, or at the end where it is coupled to another. A swage or die used for shaping metals.

4. A head or reservoir of water.

5. A master workman or superintendent; a director or manager.

boss-plating.—In *ship building*, where the shell plating is curved or *bossed* out to enclose the tail shafts of twin screws, to protect them, thus obviating long exposed lengths of shafting.

Botch.—Work done in a bungling manner; to repair; to patch in a clumsy or imperfect manner.

Both.—The one and the other; the two; the pair without exception of either.

Bother.—To feel care or anxiety; to make or take trouble; to be troublesome.

Bott-hammer.—A wooden mallet with a grooved face, used in breaking the stalks of flax and hemp.

Botting.—In founding, the act of plugging the tap-hole of the cupola with a cone of clay upon the end of a rod, after a portion of the molten metal has been withdrawn from the furnace, thus permitting more metal to accumulate.

Bottle.—A hollow vessel of glass, earthenware, wood, leather, or other material, with a narrow neck, adapted for holding and carrying liquids.

Bottle Boot.—A leather case to hold a bottle while corking.

Bottle Charger.—An apparatus for charging bottles with a liquid under pressure; as, air containing carbonic acid.

Bottle Faucet.—A small tap or cock which screws into the cork of a bottle, permitting small quantities of the contained liquid to be drawn off as required without exposing the contents to the air.

Bottle Glass.—The cheapest and coarsest kind of glass, employed in the manufacture of bottles. It is manufactured from a mixture of the silicates of aluminum, calcium, and sodium which are readily fusible.

Bottle Jack.—In construction work, a screw jack of light construction, which is slightly conical in elevation and provided with a *handle at the side* by which it is carried. Its shape is therefore, not unlike that of a jug or bottle, hence the name applied to it.

Bottle Kiln.—The common type of kiln for the preparation of lime from limestone by *burning*; so called from its sectional shape.

Bottle Molding.—In glass making, a process adapted with most kinds of commercial bottles. The bulb of glass on the end of the blow-tube is partially expanded and then placed between the parts of an iron mold which is open to receive it. The parts are closed and locked, and the bulb then expanded by the breath to completely fill the mold.

Bottle Pump.—A contrivance for drawing the liquid contents from a bottle, consisting of an india-rubber bulb used to force air into the bottle, the contents being expelled through a second tube by pressure of the air.

Bottling Machine.—An apparatus for filling bottles with liquids, consisting generally of a reservoir under pressure with several faucets, each of which can take a bottle. For *aerated* waters the bottling machine is provided with a device for inserting the cork without the escape of gas or liquid.

Bottom.—1. In shipbuilding, that part of a vessel's hull which is below the *wales*.

2. In machinery, cogs are said to bottom when their tops impinge upon the periphery of the co-acting wheel.

3. In steam engineering, a piston which strikes or touches the end of its cylinder is said to bottom.

4. In civil engineering, a circular disk with holes to secure the rods in the formation of a gabion of a fortification.

5. In ordnance, one of the plates by which grape or canister is built up into a cylinder suitable for loading into the gun. Cast iron tops and bottoms for grape; wrought iron tops and bottoms for canister.

Bottom Chord.—The lower longitudinal member of a truss; the roadway in a bowstring bridge.

Bottom Clearance.—In machinery, the distance between the *points* of the teeth of one wheel and the *roots* of another wheel, which are in mutual engagement. The clearance is given to prevent injurious grinding and friction between the points and roots.

Bottom End.—The crank-pin end of a marine engine connecting rod.

Bottom Fuller.—One of a pair of smith's tools, adapted for producing grooves in forged work, or for altering the length of bars, etc., by forming alternate grooves and ridges, to be afterwards made smooth by the swage; *bottom swage*.

Bottoming.—1. In mechanical engineering, to reach or impinge against the bottom, so as to impede free action; as, when the point of a cog strikes the bottom of a space between two other cogs, or a piston, the end of a cylinder.

2. In civil engineering, the foundation of a roadbed; ballasting beneath and around the ties of a railroad.

3. In metallurgy, the preparation of the floor of the hearth of a reverberatory furnace with mill scale or other oxides of iron, so that the decarburizing of the iron or steel shall be facilitated.

Bottoming Hole.—The furnace opening at which a bulb of *crown glass* is exposed during blowing, to soften it so that it will assume a flattened spherical form. This is previous to placing it on the *pontil* for *flashing*.

Bottoming Tap.—A plug or cylindrical tap, whose point is in no way beveled, so that it can work right to the bottom of a hole.

Bottom Rail.—1. In railroad engineering, the lower longitudinal member of a bar frame, uniting and stiffening the driving box pedestals. In consolidation and other heavy locomotives, it extends to the cylinder front.

2. In carpentry, the lowest rail of a framed or panelled piece; as, of a door, window sash, gate, etc.; the lower longitudinal bar or strip of a fence, or a piazza railing.

Bottoms.—1. In mining, the deepest workings.

2. In metallurgy, heavy and impure metallic products of refining, found at the bottom of the furnace in some of the stages of the copper smelting processes.

Bottom Stopes.—In mining, the lowest of the horizontal layers of coal, ore, etc.

Bottom Swage (or Swedge.)—The lower member of a pair of dies, between which iron bars are worked to the desired shape by a smith. The bottom swage fits into the *hardy hole* of the anvil, the smith holds the work upon it with one hand, while with the other he manipulates the top swage, which is *hafted* like a hammer, while the assistant beats upon the latter with his sledge.

Bott Stick.—In a foundry, a light iron rod about five or six feet in length, having a small disc-like expansion at one end which receives the stopper of clay used for *botting*. The other pointed end of the rod is used for tapping the hole for the egress of the metal.

Boulders.—1. A geological term applied to large detached masses of stone which have traveled a considerable way from their parent rock; the name is properly given only to those rocks which have been transported by ice in the Glacial Epoch or during recent periods. Any large piece of rock separated from the parent mass by weathering and then traveling down hill by gravitation is often termed a *tumbler*.

2. Detached rocks rounded by attrition, found in recent or ancient water courses, or else found at or near the surface in alluvial deposits over stratified rocks. These latter are frequently true boulders, and the alluvium is *boulder clay*, deposited by ancient ice-bergs or glaciers.

Boulder Wall.—In masonry, one made of boulders or flints and set in mortar.

Boulton, Matthew.—Born 1728, died 1809. An English inventor. He discovered a new method of inlaying steel, and built up a large industry in the manufacture of artistic metal work and general hardware; he constructed a steam pump (1767), and in 1775 entered into partnership with James Watt for the manufacture of steam engines. Together they greatly improved coining machinery and methods of coinage which attracted attention all over Europe, and brought them immense business in that line.

Bourdon's Gauge.—The commonest instrument for measuring the pressure of steam, water, air or other fluid, its essential part is a metal tube of a flattened oval section, which is bent to a curve, the free end being closed, the fixed end open to the pressure. The pressure tends to *straighten the bent tube*, and its consequent movement is communicated by means of linkage, a toothed sector and a pinion, to the axis of a needle or pointer; this moves around a *graduated dial*, registering the pressure of the fluid.

Bounce.—To eject violently; as, from a room; to discharge; as, from employment; a heavy, sudden and often noisy blow or *thump*.

Bound.—To limit; to terminate; to fix the furthest point of extension.

Boundary.—That which indicates or fixes a limit or extent, or marks a bound; as, of a territory; a bounding or separating line; a real or imaginary limit.

Bow.—1. In mechanical engineering, any instrument consisting of an elastic rod, with ends connected by a string, employed for giving reciprocating motion to a drill, or for preparing and arranging the hair, fur, etc., used by hatters.

2. In ship building, the bending or rounded part of a ship forward.

3. In navigation, a rude sort of quadrant formerly used for taking the sun's altitude at sea; one who rows in the forward part of a boat, the *bow oar*.

Bow Compasses.—Draughtsmen's compasses for describing small circles, differing from the ordinary pattern by having a handle, set above the top joint, which is convenient for twisting the instrument around between the thumb and finger. The points are not made detachable, each bow being constructed for one purpose, only, with a *pencil* or an *ink point*, thus making two to a set. Also called *spring bows*.

Bow Drill.—A drill operated by means of a bow, the cord of which is given one or more turns around the handle of the drill, and alternate revolution in opposite directions imparted to it by alternately reciprocating the bow backward and forward.

Bower Anchor.—A large anchor carried at the bow of a ship.

Bowking.—In cotton manufacturing, the process of boiling in an alkaline lye in a *kier* being part of the process of bleaching.

Bowl.—1. A concave vessel used chiefly for liquids.

2. In manufacturing, a roller or antifriction wheel, of a knitting machine, on which the carriage traverses.

Bowline.—In navigation, a rope near the middle of a square sail to keep the ship up in the wind.

Bowline Knot.—A useful knot for making a loop that will not slip upon the end of a line. To make it, a *bight* is formed in the rope, near its end, with a half twist, making a loop. The rope's end is passed up through this loop, around the standing part, through the loop once more, the knot being then pulled *taut*.

Bowling Hoop.—A hoop or ring of U-section, connecting the lengths of a furnace flue, strengthening it and yet permitting expansion.

Bow Pencil.—A form of compass of the smaller kind which is capable of delicate adjustment for describing minute circles and arcs of small radius. The mode of adjustment is similar to the bow-pen; a black lead-pencil pared down to a small size, or the lead from a pencil, is clamped in the socket and is advanced as it wears or is shaved away in sharpening.

Bows.—In wagon making, bows are secured by strap iron to the side of the wagon, and are used to stretch and support the canvass or covering of the top of the wagon.

Bowsprit.—A yard or spar projecting forward from the bow of a ship; from it are stayed the fore top mast and top gallant mast, it being stayed in turn from the stem of the ship by the *bobstay*.

Bowstring Bridge.—One in which the horizontal thrust of the arch or trussed beam is resisted by means of a horizontal tie attached as nearly as possible to the chord line of the arch.

Bowstring Girder.—A truss used in bridge construction, having the form of an arch or bow, the road way corresponding to the string or chord.

Box.—1. A receptacle, generally rectangular, provided with a lid, and used for storing articles, generally having a word prefixed to it to denote its use, as *tool-box*, *die-box*, etc.

2. A portion of a mechanism, bearing a resemblance to a box; as, the *valve box* or chamber in which works a ball or *check valve*.

3. A bearing for a journal; as, one for the axles of railway vehicles.

4. A space enclosed or partitioned off for any purpose.

Box Anchor.—A cast iron frame or dovetail built into a masonry wall, designed to receive and support the end of a timber beam or *girder*.

Box Beam.—In architecture, a beam made of *metal plates* so as to have the form of a long box.

Box Car.—The common freight vehicle of railroads, mounted on two four-wheeled trucks, and having enclosed roof and sides to protect its contents.

Box Chain.—In architecture, a chain constructed with upright sides, and with flat top and bottom.

Box Coil.—An arrangement or *stack* of heating pipes, parallel with each other, their ends connected by *return bends*.

Box Coupling.—A cylindrical coupling for uniting two lengths of coupling, more commonly termed a *sleeve coupling*; a *muff*.

Box End.—A style of connecting-rod end, in which the D-shaped slot for the brasses is machined out of the solid, instead of their being secured by a separate strap or stirrup shaped piece. Used for the cross head end of locomotive rods, where they are not bushed, and sometimes for the crank-pin end of side-hitch stationary engines, also called *strap end*.

Box Frame.—In carpentry, the enclosed space each side of the sash in a window frame, in which the sash weights move up and down.

Box Girder.—A girder of rectangular section usually built up of two parallel I beams with plates riveted upon top and bottom, thus forming a very strong shape of box section.

Box Hook.—The same as *bale hook*; a sharp pointed steel hook with a wooden T-handle, used by stevedores, etc., to seize bales, boxes, etc., which afford no other means of gripping them.

Box Horse.—In *civil engineering*, a square frame constructed of stout planks, used as a support for *barrow runs*, used in removing the spoil from an excavation.

Boxing.—In wood working, the fitting of the shoulder of a tenon in the surface of the timber, which is mortised for the reception of the *tenon*.

Boxing Up.—In pattern making, the construction of large patterns from boards instead of cutting them from the solid.

Box Lifter.—A moulder's lifting tool, with a box-like receptacle; it is held in one hand to catch loose portions of sand, while cutting out a gate, etc., with the other.

Box Lock.—A large door lock, with a wooden casing, designed to be attached to the surface of the door which it fastens.

Box-making Machine.—A machine, in which the bottom, side, and end pieces of a box are set in place and their nails driven by advancing punches, which sink them into place.

Box Metal.—In steam engineering, a term sometimes applied to the metal used for bearings; it may be gun metal or a white metal. One recipe gives copper 32, tin 5; another gives zinc 75, tin 18, lead 4-5, antimony 2-5.

Box Nut.—In machinery, a nut made for the covering and protection of the end of a bolt. It is similar to an ordinary nut, with the addition thereto of a dome shaped closed end. The screwed part is also terminated internally in a circular recess larger in diameter than the deepest portion of the Vee of the thread in order that the cutting tap shall clear itself. Box-nuts are used on the covers of locomotive cylinders and in similarly exposed situations. The screwed bolt ends and their nuts are thus both alike protected from rust or accident, hence there is no difficulty in slackening back when necessary. Also called *cup nut*.

Box Pattern.—Applied to an engine or machine framing when it is cast in a deep cored section, as contrasted with a plate form having numerous stiffening ribs. The frame of a so-called Tangye engine is of a *box pattern*, the ordinary Corliss frame is of the *girder type*.

Box Scraper.—A sort of single handed *drawing knife* or reverse plane, used by box makers to dress their work.

Box Seat.—The driver's seat of a four-in-hand or omnibus, so called from the *receptacle under it*; hence, the driver's seat in certain automobiles.

Box Sextant.—A portable surveying instrument, somewhat after the shape and size of a prismatic compass, by means of which angles in a horizontal plane may be observed.

Box Spanner.—A socket wrench or T-spanner; having a socket to fit the nut, and a shank vertical to it, either turned by means of a toggle or by the T-handle. Used for turning nuts sunk in a recess below the surface of the piece.

Box Truck.—A very strong frame mounted on four low wheels, somewhat larger than castors, making a very convenient appliance for handling heavy packing cases in a warehouse, etc.

Box Van.—In transportation, a large covered wagon of which the upper section or box is of an extra large size, raised.

proof and padded out with some very soft material, and used for removal of furniture, valuable paintings, etc.

Box Vice.—The usual type of bench vice, in which there is a leg supporting it from the floor.

Box Wood.—The timber of an evergreen tree found in Europe, Asia and Africa, the chief supply coming from the Levant. The wood is very hard and heavy, of a close grain and a light yellow color; it is the chief material used for wood engraving; is employed in the making of musical instruments, turnery, handles of tools, etc.

Box Wrench.—A box-spanner or *socket-wrench*.

Boyle's Law.—At constant temperature, the pressure of a gas varies proportionately to its volume, in an inverse ratio. Thus, if the supply be cut off at half-stroke, the final pressure is half of the initial, assuming no change in temperature. While this is strictly true of perfect gases alone, it is only approximately correct for imperfect gases, such as steam.

Brace.—1. Anything which holds or sustains anything from without or within; or a detail which serves to interlock various portions of a structure, binding it into a solid whole.

2. In engineering, a rod or bar employed to link two parts of a structure together, thus stiffening and strengthening it. A *brace* is always in tension; if a similar member be in compression, it is termed a *strut*.

3. A name sometimes applied, for the sake of differentiation, to the larger *stays* in a boiler.

4. In timber buildings, a diagonal support employed at the various angles of the structure; a *knee* to sustain vertical members.

5. A curved instrument for holding and rotating drills and similar tools. A *bit-stock*.


Braced Frame.—In building, the full-frame method of erecting timber structures, in which heavy scantlings are employed, each member being tenoned and fitted into its proper place.

Braced Girder.—In structural iron work, a built up girder of wrought iron made by uniting top and bottom angle irons with lattice work of diagonal bracing; the other flanges of the angle irons being attached by riveting to top and bottom plates.

Brace Drill.—A drill-bit specially made to fit a brace or *bit-stock*.

Brace Measure.—The scale seen on the center of the tongue of a *steel square*,

used for determining the length of a brace where the *run* on the sill and the *rise* on the post are the same. The figures also give the length of diagonal of a square whose side is known.

Brace Mould.—A moulding sometimes used in architecture, having a profile like the brace , formed of two ogees with a small bead between them.

Brace Wrench.—In machine shop practice, a box spanner with the shank or tail curved like a *carpenter's brace*, thus enabling nuts to be taken off or put on a joint with great rapidity.

Bracing.—In construction work, the staying or supporting of an inherently weak structure with rods and ties. The object of bracing is the conversion of transverse stresses into those of a longitudinal character. Tensile or compressive braces take the form of triangles, since that is the only figure which maintains its form unaltered while the lengths of its sides remain constant. Bracing is practised in all built up structures and the calculation of the strain on the different members comprising the structure is obtained readily by graphic methods, or by the method of moments.

Bracket.—1. A piece, or combination of pieces, of wood, stone, or metal, triangular in general shape, and either plain or ornamented; usually projecting from, or fastened to a wall or other surface, for supporting shelves or other objects, or to strengthen angles.

2. In architecture, a projecting ornament carrying a cornice.

3. In engineering, a projection in a mechanism or structure which provides support or attachment for another detail. Brackets are made in a variety of forms to suit different purposes, the general idea being a small piece of an angular section, like the letter L.

4. In mathematics, a parenthesis employed in pairs, as [], () or { }, denoting that all the numbers within them must be taken as one quantity.

5. In gas fitting, a supply pipe and mounting for a gas burner and its globe or shade; the bracket projects horizontally from a wall, and is usually fitted with one or more joints so that it may be swung into different positions.

Bracket Box.—A type of pillow-block, or shaft bearing, which is attached as a bracket to a wall or pillar, instead of being mounted upon its base.

Bracket Chain Wheel.—The sprocket chain driving wheel, which is carried on the crank bracket of a *bicycle*.

Bracket Saw.—In carpentry, a saw with a relatively long narrow blade, used in cutting brackets, frets, scrolls, etc., on verge boards, ornamental work, etc.; also called *fret saw*.

Bracket Valve.—A stop-valve, with a bracket cast upon its body, so that it may serve as an anchorage or support for the piping which it controls.

Brackish.—Said of water, when partially saturated with salt, or mixed with seawater.

Brad.—A kind of nail, with a slight projection at one side of the top, instead of a head; used for laying flooring boards, etc.

Brad-awl.—An awl to pierce holes in wood for the insertion of brads, it pierces the fibers and then thrusts them aside, not extracting any.

Brad Punch.—A punch or set used by joiners to drive the brads below the surface of the board, so that they will not project or be visible. The small hollow is generally filled with putty. Also called *nail-set*.

Brahmah, Joseph.—Born 1749, died 1814. An English machinist and inventor. In 1778 he patented a sanitary device for water closets which was the first of a long series of patents acquired by him. His next invention was a safety lock which until 1851 preserved the reputation of being unpickable; he made valuable improvements in many existing machines as, for example, in pumps, fire-engines, steam-engine boilers, printing machines, but his principal contribution to mechanical development was the hydraulic press (1795) which was later perfected by Maudslay.

Braiding.—The act or process of plaiting or interlacing three or more threads or strands together, to form a continuous fabric, by weaving them alternately over and under each other.

Brails.—In navigation; ropes used to gather up the foot and leeches of a sail, preparatory to furling. The brails of a *gaff-sail* are for hauling the after leech of the sail forward and upward, previous to furling; the *lee brails* are hauled upon in furling.

Braize.—Fine coal, or *breeze*; also washed and sorted cinders used by toolsmiths, etc.

Brake.—1. A contrivance for checking or controlling the speed of a vehicle or machine by means of friction applied to a drum, or wheel; the friction is applied either by means of a band or by pressure on a shoe.

2. A contrivance for measuring the useful effort of a *prime mover* by the substitution of measurable friction for the external load. It consists essentially of a band, usually of steel

shod with wooden blocks, which encircles a fly wheel or pulley, the friction of the brake sustaining an arm or lever, to the ends of which either weights or a steelyard are attached.

3. A machine or tool for the separation of pith and bark from the fibers of flax and hemp.

4. A removable handle or lever for a pump, or machine which is operated in similar manner to a hand pump.

Brake Band.—The strap or band of a brake which encircles the drum or pulley; either made of iron alone or of iron faced with leather, wood blocks, etc. An efficient brake band for *absorption dynamometers* has been constructed of a coil of $\frac{1}{4}$ " gas tubing, through which circulating water flows to absorb the heat generated by friction.

Brake Clutch.—A name sometimes applied to the *expanding brake* fitted to certain automobiles, on account of its resemblance to a friction clutch.

Brake Drum.—A pulley or drum fixed upon the axle of an automobile, on which the brake acts, as it would not be practicable to apply a brake to the pneumatic tires. Also called *brake-wheel*.

Brake Head.—In railway practice, a metal casting secured to the end of a brake-beam or hanger to hold a brake-shoe. The shoe is cast with lugs which fit into corresponding recesses in the head and a thin tapered key holds the two securely together. By withdrawing the key the worn out shoe can be quickly removed and a new one substituted. In Great Britain the brake head and shoe are commonly made in one piece, and called a *brake-block*.

Brake Horse-power.—The useful horsepower supplied by an engine as ascertained by the application of a brake, or *absorption dynamometer*. The excess of the indicated horsepower over that given by the brake, represents the power required to move the engine itself, and is generally spoken of as internal load or internal resistance.

Brake Lever.—In vehicles, the lever by which the brake is applied to the wheels.

Brake Machine.—In power bakeries, a kneading and incorporating machine for dough, used in the manufacture of biscuits.

Brakeman.—1. The man whose business is to manage the brake on railways.

2. The man in charge of a winding-engine at collieries.

Brake Rigging.—The combination of rods and levers by which the brakes are actuated on a locomotive or car.

Brake Rod.—In automobiles, the rod connecting the brake with the lever which applies it.

Brake Shaft.—In railway engineering, a vertical iron shaft on which a chain is wound, and by which the power of a hand-brake is applied to the wheel of a tender.

Brake Shoes.—Blocks of cast-iron or wood that are pressed upon the circumference of the wheels to check the motion of a railway train or other vehicle.

Brake Wheel.—1. In railroad engineering, the wheel on the platform or top of a car by which the brakes are operated.

2. In machinery, a wheel having cams or wipers to raise the tail of a hammer-helve.

Bran.—The broken coat of the seed of wheat, rye, or other cereal grain, separated from the flour or meal by sifting or bolting; the coarse, chaffy part of ground grain.

Branca, Giovanni.—An inventor of Loreto, Italy. In the year 1629 he designed an engine shaped like a water wheel, designed to be driven by the impact of a jet of steam on its vanes, and, in its turn, to drive other mechanism for various useful purposes. There were other inventors in the field in the early part of the same century in which Branca lived, and his suggestion being unproductive, the course of invention reverted to the line followed by Della Porta and De Caus.

Branch.—1. In railway working, a local or auxiliary line leading from the main route to points on either side of it. Also called *spur*, *loop*, etc.

2. A pipe set off from a main pipe at any angle, either conducting the contents of the pipe in a desired direction or acting as a feeder to it.

3. In mining, a small vein or stringer leading out of the main lode.

Branch Chuck.—In machine shop practice, a chuck formed of four branches turned up at the ends, and each furnished with a screw to grip the work.

Branch Pipe.—A junction pipe of cast metal, consisting of a length of the standard pipe with one or more branches proceeding from it, of either the same or a smaller size.

Brand.—1. To impress a mark by burning; as, upon wood, or the skin of living animals, for the purpose of marking permanently.

2. To brand metals for the purpose of denoting quality, date of inspection, manufacturer or similar information.

3. A quality or variety of material so branded.

Brander.—In building, when large timbers have to be plastered, pieces of wood, termed *branders*, about one inch square are nailed as furrings to the timbers, for securing the laths which carry the plaster; *furring*.

Bran Duster.—A dressing machine for flour, in which small particles yet adhering to the bran are removed either by rolls or by brushes set upon the circumference of a revolving conical cylinder.

Branning.—In tanning, the preparatory process of soaking skins in a fermenting mixture of bran and water; as, with calf-skins. Also used to prepare cloth for dyeing; generally termed *drenching*.

Brasque.—A mixture of coal or coal dust and coal tar, with or without the admixture of powdered graphite or gas carbon; used as the lining of certain furnaces to prevent the corrosion of slags.

Brass.—A yellow alloy composed of copper and zinc in various proportions. In some grades tin or lead in small amounts is added. Brass is used largely for steam and plumbers fittings, electrical details, builders' hardware, musical instruments, etc.

Brass and Brass.—A shop term, used to denote that the two boxes or brasses of a bearing are locked together by the cap, key or set screw.

Brass Bench.—The bench of the brass moulder consists of a plain table either of wood or iron, upon which the moulding flasks are manipulated, and of a bin or trough containing the sand.

Brass Borings.—The borings and turnings of brass castings collected in the shops, separated from those of iron.

Brasses.—Bearing steps cast from an alloy of copper and zinc. Generally, all loose bearing pieces or steps are termed *brasses*, though they are most usually made either of *bronze* or *gunmetal*, a copper-tin alloy, or else of cast-iron or steel fitted with recesses filled with a *white* or *anti-friction* metal, composed of tin, zinc, antimony or lead, with occasionally copper.

Brass Finisher.—A workman, either viceman or machinist, who is engaged in the manufacture of articles composed of copper alloys. It is regarded as a special trade.

Brass Finishing.—The later stages of the manufacture of brass cocks, valves, lubricators, and similar engine and pump fittings. It is a special branch carried on in a department or in a factory by itself. It combines turning, milling, grinding and burnishing.

Brass Foil.—Very thin beaten sheet brass, thinner than latten. *Dutch gold.*

Brass Furnace.—A small furnace for melting brass, the metal being contained in crucibles. The fuel is generally coke, and a fan blast may or may not be used.

Brassing.—In metal working, giving a brass coat to copper. It may be done by. (a), exposing the copper in a heated state to the fumes given off by zinc at a high temperature; (b), by filling a copper vessel with water soured by hydrochloric acid and adding an amalgam of zinc and cream of tartar, and boiling the whole for a short time.

Brass Moulder.—A workman specially trained in moulding and casting brass—one who seldom touches iron moulding.

Brass Tubing.—In materials, is used in engineering for cutting off into hand railings, sheathing, distance pieces, etc. Its thickness is given by the wire gauge. The common tube is soldered or brazed; but the best tubes as used for condensers are solid drawn, and usually made of a special alloy.

Brasswork.—In metal working, all work made of brass, for ornamental or useful purposes, as on elevator fronts, on ships and yachts, on machinery, bedsteads, etc.

Brattice.—A vertical partition in a mine shaft, separating the pumping machinery part from that in which the cages work.

Brazier.—1. A worker in sheet brass or copper, especially in the manufacture of domestic and culinary utensils.

2. A portable fireplace with open bars, used in different forms in nearly all countries, from the remotest times.

Brazil Wood.—A very heavy wood of reddish color, imported from Brazil and other tropical countries, for cabinet work, etc.

Brazing.—The art or process of joining metals together. The parts to be united are cleaned, covered with borax as a flux, the *spelter* or brass-alloy is placed on the joint, which is heated until the spelter runs in, when it is allowed to set, superfluous brass being afterwards filed off.

Brazing Metal.—An alloy composed 84% of copper and 16% of zinc. Flanges for copper pipes are cast from this, the percentage of copper having to be high to stand the localized heat of brazing to the tube.

Breach.—A gap or opening made by breaking or battering; as, in a wall or fortification; the space between the parts of a solid body rent by violence.

Breadth.—Distance from side to side of any surface or thing measured across, or at right angles to the length; *width.*

Break.—In naval architecture, a point where the deck of a vessel suddenly terminates and the descent to the next deck begins.

Breakdown.—An accident which causes stoppage of the machinery; as, of a railway train.

Breakdown Gang.—A body of men sent from division headquarters in the *breakdown train*, which consists of a traveling steam-crane, a tool-car, and also ambulance facilities, to deal with an accident, clearing the line and repairing it where necessary to resume traffic. The same as *wrecking-crew.*

Breakers.—1. Waves of the sea or ocean breaking into foam on a beach, or against a sand bank or a rock or reef near the surface.

2. In navigation, small water barrels or casks, which are put in each life boat of a ship, provided with water for drinking purposes in case of shipwreck.

3. In mechanical engineering, machines for breaking rocks, or for breaking coal at the mines, also the *buildings* in which such machines are placed.

4. In weaving, the first carding machine which operates upon the parcels of tow from a creeping sheet. The *finisher* is the final carding machine and operates upon a *lap* formed of *slivers* of line.

Break Ground.—To commence excavation; as, for a building or any other engineering enterprise.

Breaking.—In a foundry, when molten iron is poured into a ladle, its surface shows a multitude of continually varying curves due to the rising up of the metal beneath. Different qualities of metal have different aspects, so that a founder can distinguish between hard and soft iron while yet in the ladle, and can also judge roughly of its temperature.

Breakingdown Point.—In physics, that point in the stressing of a material in which the deformation increases very suddenly. It occurs immediately beyond the elastic limit, and is marked by a well defined and sudden curve in the stress-strain diagram.

Breaking Engine.—In paper-making, the machine in which the rags, etc., are reduced to *half stuff* by means of a rotating cylinder, armed with sharp knives, working above other knives set in the bed of an oblong trough. The trough is divided longitudinally by means of a vertical partition or *midfeather*.

Breaking Frame.—In woolen manufacture, a machine which splices and stretches the slivers of yarn.

Breaking Piece.—In rolling-mills and other mechanisms subject to violent shocks, one part of a shaft is made of less diameter than the rest, so that if anything has to break, the fracture is always located in this short piece of reduced diameter. A number of these can be kept on hand as *spare gear*, and quickly substituted for the broken piece.

Breaking Strain.—The effect, resulting in rupture, occasioned in a material by a stress or load equal to or greater than its *tensile strength*.

Breaking Strength.—In physics, the ultimate resistance to rupture of a piece of material of specified size; usually expressed as ability to resist *tensile stress*, but also to be considered with regard to *shearing* or *compressive stresses*.

Break Iron.—In carpentry, the iron screwed on top of a plane-bit to bend upward and break the shaving. Its edge is from 1-16 to 1-64 of an inch from the edge of the cutting bit.

Break Joint.—In building and engineering, so arranging the parts of a structure that two or more successive joints may not come in line with each other, a solid part intervening opposite each joint. This adds to the strength of the structure, as in bonding masonry, or prevents leakage or promotes equal wear as in the joints of packing or piston rings,

Break Lathe.—A large lathe whose bed is constructed in two pieces, so that the upper part can be slid back from the

fast headstock, thus permitting large work to be swung. More commonly called *gap-lathe*.

Break Rolls.—The first series of rollers in a flour mill which crack or break the cleaned and conditioned wheat berry.

Breakwater.—A wall or pier-like structure to break the force of the waves and make a sheltered anchorage for shipping.

Breakwater Glacis.—In civil engineering, a storm pavement; the sloping stone paving next the water in piers or breakwaters.

Bream.—In navigation, to clean; as, a ship's bottom of adherent shells, seaweed, etc., by application of fire and scraping.

Breast.—1. In mining, the working face at the end of an adit, drift level or slope.

2. In building, that portion of a wall, projecting into a room, which encases the chimney flues.

3. In founding, the lining of the opening through which molten iron is drawn from a cupola. The breast is made of a good refractory material, and is built daily around a mould which gives the proper form to the *tapping-hole*.

Breast Board.—In rope making, a loaded sled to which are attached the end yarns of the foot of the walk. As the yarns are twisted into a strand, they become shorter and draw the sled towards the head of the walk, the load on the sled maintaining the necessary tension. The yarns are usually shortened one-third by the twisting and lose about thirty per cent in so doing. The twist is, however, necessary to give requisite rigidity, to prevent the fibres sliding on each other, and to partially exclude wet. The addition of tar increases the power of excluding water. Rope not twisted, but bound tightly together, is stronger than twisted rope, but is soft and not durable, the yarns readily admitting water which rots the rope.

Breast Drill.—A class of drill, either turned by a crank and bevel wheels, or by a bow like a fiddle drill. It has a plate at the end of the stock upon which the workman presses his breast while drilling.

Breast Hook.—In ship building, one of the curved horizontal timbers placed inside the bow to support and connect the sides; also called *breast knee*.

Breasting.—In paper-making, the curve of the bed plate of a breaking or beating engine, conforming to the curvature of the roll.

Breast Rail.—A railing breast-high around a balcony, or the railing around the quarter deck of a ship.

Breast Roll.—In paper-making, the first roll in the continuous machine, on top of which the apron rests.

Breast Wall.—1. In masonry, a wall built breast high.

2. A wall erected to maintain a bank of earth in position as in a railroad cutting, a sunk fence, etc. The thickness and batter of the breast wall depend upon the character and inclination of the strata. It is held to be a safe rule to make the base of the wall not less than one fourth and the batter not less than one sixth of the vertical height of the wall. Where the strata are horizontal, a mere casing may be sufficient, but its strength must be considerably increased when the strata incline towards the wall. The thickness required will also depend upon considerations of the cohesion of the earth, dryness, or tendency to moisture, drainage, and the peculiar superposition and dip of strata indicating land slips.

Breast Wheel.—A type of water wheel intermediate between the over shot and under shot. The water strikes it at a point 30° to 45° from its summit, for a *high breast*; at the level of its axle for a *low breast*. The wheel revolves in a curved bed or *breast* of masonry or timber, which has half inch clearance for an iron wheel with masonry, or one inch for wood. This breast terminates about a foot short of the vertical diameter of the wheel. Breast wheels are suitable for falls over six feet, and are more efficient than overshot wheels when there are fluctuations of two feet or more in the level of the head race.

Breath.—The air inhaled and exhaled in respiration; air, which in the process of respiration, has parted with oxygen and has received carbonic acid; aqueous vapor, warmth, etc.

Breccia.—In mining, a conglomerate rock composed of angular fragments cemented together, as distinguished from true conglomerate in which the stones are rounded. This shows that the stones composing a *brecciated rock* have not been exposed to the action of running water.

Breeches Buoy.—In the life saving service, a pair of canvas breeches attached to an annular or beltlike life buoy which is usually of cork. This contrivance, enclosing the person to be rescued, is hung by short ropes from a block which runs upon the hawser stretched from the ship to the shore, and is drawn to land by hauling lines.

Breeches Pipe.—A Y-shaped pipe used for many purposes, especially in locomotives, leading the exhaust from the two cylinders to the blast nozzle.

Breeze.—Finely subdivided or dust fuel. A blacksmith often uses the sifted, well-washed cinders of coal or the powdered coke. In brick making, sifted fine cinders are used for laying between the

layers of bricks in a clamp for burning. Breeze is often used for mixing with concrete, or with the loam to make bricks.

Bressummer.—In building, a corruption of *breast-summer*; a large beam which supports a wall or partition; the girder which supports the wall over a store window-front.

Brick.—A rectangular block of clay, moulded to regular sizes, and burnt to give it hardness and durability. The usual sizes average $8\frac{1}{4} \times 4\frac{1}{4} \times 2$. The color of bricks depends upon the amount of ferric oxide in the clay, ranging from white with 1 per cent. through buff and orange to a deep red with 6 per cent. Common bricks are made from a marly or sandy clay or an artificial marl termed *malm*, made by mixing chalk with the clay.

Brick Arch.—In railway engineering, an arch built up of fire bricks placed transversely across the fire box of a locomotive boiler in front of the tubes and sloping downwards and backwards, its purpose being to deflect the flame and hot gases backwards and so prevent them from passing into the tubes too rapidly.

Brick Arch Tube.—One of a series of curved iron tubes used to support the firebox arch in certain locomotives, also providing increased heating surface and promoting circulation.

Brick Bat.—A bricklayer's term describing a divided brick. Divided longitudinally, it is termed a *closer*.

Brick Clay.—A clay suitable for brick-making, naturally containing less water than other descriptions. The composition varies considerably, the plastic or *strong* clays containing oxides and phosphates of iron, besides the aluminum silicate or true clay.

Brick Dryer.—An oven in which green bricks are dried, so that they may be fit for building up into kilns for burning.

Brick Dust.—The dust from disintegrated bricks; powdered bricks; especially that from Bath bricks, used mainly for polishing and cleaning.

Brick Elevator.—An apparatus for raising materials used in construction. An endless chain running on a head and foot gear, carries the required materials in boxes, made of sheet iron and riveted or bolted to the chain. The foot shaft, with its sprocket wheels, is brought in motion by the turning of two handles, fastened one on each end of the shaft.

Bricking.—Brick-work, or an imitation of brick work on any surface.

Brick Kiln.—A chamber in which green bricks are loosely stacked with spaces between them, for the passage of the heat, and in which they are burned by fire placed either in arched furnaces under the floor of the kiln or in fire holes placed in the side walls.

Bricklayer.—One whose business is the placing or laying of bricks; as, in a wall.

Bricklayer's Hammer.—In masonry, a tool having a hammer head and a sharpened *peen*, forming an axe for dressing bricks to shape.

Brick-nogging.—A brick-nogging wall or partition is one in which the spaces between the timbers or scantlings are filled up with brick laid in mortar. In a brick-nogging partition, the wooden portions are called *nogging-pieces*.

Brick Trowel.—In masonry, a bricklayer's tool with a thin, pointed blade of tempered steel, for taking up and spreading mortar, and also for cutting bricks to any required size, by a blow with the edge.

Brickwork.—Bricks laid in mortar or cement, properly bonded. Mortar is used under ordinary circumstances, cement where water, acids, gases, or sewage come into contact with the brick work.

Brick Yard.—A place of manufacture of building bricks, so called from the large area originally required for lines of moulded bricks drying in the air, preparatory to burning.

Bridge.—1. In civil engineering, a structure erected over a waterway, ravine or road, for the passing of persons, animals, railroads or vehicles.

2. In steam engineering, a lower vertical partition at the back of the grate space of a furnace. The flame in passing the bridge is deflected upward against the bottom of the boiler.

3. In shipbuilding, a partial deck extending from side to side of a vessel forward, and used by the officer in command as a convenient station to overlook and from which to give his orders.

4. In metallurgy, the low wall of division between the fuel chamber and hearth of a reverberatory furnace.

5. In mining, the platform or staging by which ore, limestone, fuel, etc., are conveyed to the mouth of a smelting furnace.

6. In engraving, a board resting on end cleats, used by an engraver to span the plate on which he is working, to support the hand clear of the plate.

7. In watchmaking, a piece raised in the middle, and fastened on both ends to the watch plate and forming a bearing for one or more pivots.

Bridge Board.—In carpentry, a notched board to which the *treads* and *risers* of a stair are fastened. A *notch board*.

Bridge Deck.—In shipbuilding, an enlarged bridge forming a partial deck.

Bridge Floor.—In carpentry, a floor in which bridging joists are used without girders.

Bridgeover.—In carpentry, a term showing that certain parts lie across and rest on others; as, common joists, *bridgeover* binding joists, etc.

Bridge Pedestal.—In bridge construction, an iron socket, or support for the foot of a brace at the end of a truss where it rests on a pier.

Bridge Piece.—In machine shop practice, in gap lathes, the loose piece of the bed which fits into and bridges the gap.

Bridge Plates.—A cheap quality of iron similar to ship plates. Its tensile strength is low, about eighteen tons or even less to the inch, and it is brittle, having but two or three per cent. of ultimate set.

Bridge Pot.—In mill-gearing, a bridge-piece which supports the footstep, when bevel-gear driving is employed. In this case the step slides up and down within the bridge pot, and is raised or lowered by means of the *yoke lever* when adjustment of the mill stones is desired.

Bridge Rail.—A rail resembling an inverted Ω in section; formerly very much used, and still employed in special circumstances, such as around dock yards, and mountain railways. The bridge rail is generally used in conjunction with continuous longitudinal sleepers, so that the whole of the rail is supported.

Bridge Tree.—In millwrighting, the crossbar of a turbine frame, above the casing, which affords a bearing and central support for the spindle; a lever which sustains the footstep of a millstone spindle, by raising or lowering which the distance between the faces of the two stones is altered as required.

Bridge Truss.—In civil engineering, a structure of thrust and tension pieces, forming a skeleton beam. It has several varieties: the lattice, the arched truss, or combination of arch and truss, the deck truss, in which the roadbed is on straight stringers.

Bridge Wall.—A transverse wall of fire-brick placed in the throat of a boiler furnace, at the end of the fire grate. It prevents the admission of air except over or through the fuel, and forces the currents of flame and gases to transverse the crown of the furnace, and mingle together in so doing.

Bridging.—Diagonal struts employed to stiffen flooring joists and partition studing, by being placed between them.

Bridging Joist.—In carpentry, a joist in a double floor, resting upon the binding joist, and supporting the floor. A *floor joist*.

Bridle.—1. In navigation, a mooring hawser; a span of rope, line or chain made fast at both ends, so that another rope, line or chain may be attached to its middle.

2. In steam engineering, the flange of a slide-valve to hold the rod in position.

3. The clamps around a mast for affixing a *goose neck*.

Bridle Iron.—In architecture, a strong flat bar of iron, so bent as to support, as in a stirrup, one end of floor timber, etc., where no sufficient bearing can be had; called also *stirrup* and *hanger*.

Brief.—Short in duration; concise; soon; quickly.

Brig.—In navigation, a two masted vessel, square rigged on both masts. It has a gaff-sail on each lower mast; that on the mainmast is called the *driver*.

Brigantine.—In navigation, a two masted vessel, brig rigged with the exception that it has a fore and aft main sail; originally a pirate vessel.

Bright Red Heat.—In tempering, a stage of temperature when the black scales on the surface of iron are thrown into relief against the red background and which corresponds roughly with a temperature of 1800° F.

Bright Work.—The polished parts of a steam engine or other machine.

Brim.—The rim, border, or upper edge of a dish, or any hollow vessel used for holding anything.

Brimstone.—The common name for artificially prepared *sulphur*—so called from its burning qualities.

Brine.—1. A saline solution; salt water.

2. A strong solution of saltpetre or of common salt, used in pickling meat.

3. In refrigeration, the circulating medium which is cooled by the gasification of the volatile agent, and is then passed through pipes suitably disposed, within the ice-forming tank, or around the cold-storage chambers. The solution most commonly used is that of *calcium chloride* (chloride of lime), as it is less liable to clog or corrode the pipes than a solution of sodium chloride (common salt). The freezing point of either fluid is considerably below that of water, hence its employment.

Brine Agitator.—In refrigeration, a small propeller wheel which keeps up a constant motion in the brine within an ice freezing-tank.

Brine Coils.—In refrigeration, the coils of pipe through which ammonia is vaporized to cool the brine in the ice freezing-tank.

Brine Evaporator.—An apparatus for evaporating brine, in order to produce salt. The common furnaces for this purpose have a row of pans set above a long arch; shelving sides hold the salt as it is dipped out, and allow it to drain into the kettles. The pan bottom is double, forming a *steam jacket* and the multifue boiler also forms a jacket around the fuel chamber. The flame and heat, after direct passage through the flues, pass backwardly alongside the furnace jacket and beneath the steam jacket of the pan.

Brine Gauge.—An instrument used for measuring the saltiness of a liquid; also called *salometer*.

Brine Pump.—A pump, generally with a brass water-end, used to circulate the brine in a *refrigerating* or ice-making plant.

Brine Valve.—In marine engineering, a valve which is opened to allow water saturated with salt to escape from the boiler; commonly termed *blow-off* valve.

Bring.—To convey; to move; to carry or conduct; to bear from a more distant to a nearer place; to fetch.

Brining.—In marine engineering, the act of discharging brine from a boiler at regular intervals so as to maintain a certain density.

Brink.—The edge, margin, or border of a steep place, as of a precipice; a bank or edge; as of a river or pit; a *verge*; a border.

Briquettes.—Patent fuel composed of tar, anthracite dust and sawdust, compressed together into cubes or small oval blocks. Various mixtures are employed to utilize waste coal-dust.

Bristol Board.—A fine kind of paste-board used for drawings, sketches, etc.

Bristol Brick.—A brick composed principally of granular silicious matter; used for polishing steel, etc. The name is derived from the city of Bristol, near which they are made in large quantities.

Britannia Metal.—A white metal alloy, resembling silver in some degree, and used for making table-ware, &c. There are several formulas for compounding this white alloy, which differ according to their manufacturer, but in all of them *tin* is the principal ingredient, to which antimony, copper, brass, zinc, bismuth are mixed in different proportions.

British Thermal Unit.—That quantity of heat required to raise the temperature of one pound of pure water one degree Fahr., at or near 39.1° F., this being the temperature of the maximum density of water.

Brittleness.—In the materials of machine work this usually goes along with *hardness*. The hardest and most highly tempered steel is the most brittle; white iron is more brittle than grey, and chilled iron than any other. The brittleness of castings and malleable work is reduced by annealing.

Broach.—1. In machinery, a tool of steel, generally tapering, and of polygonal form, with from four to eight cutting edges for smoothing and enlarging holes in metal; sometimes made smooth or without edges, as for burnishing pivot holes in watches; also called a *reamer*.

2. In machinery or iron work, a straight tool with file teeth made of steel, to be pressed through irregular holes in metal that cannot be dressed by revolving tools; also called a *drift-pin*.

3. In masonry, a broad chisel for stone-cutting.

4. In architecture, a spire rising from a tower.

5. In locksmithing, the pin in a lock which enters the barrel of the key.

6. In wax candle manufacture, the stick from which candlewicks are suspended for dipping.

Broach Post.—In carpentry, also called *king post*, a main post beneath the crown or ridge of a roof frame.

Broad.—A bent turning tool, or one formed of a disk, with sharpened edges secured to a stem. Used for turning down the insides and bottoms of cylinders in the lathe.

Broad Axe.—A carpenter's axe for hewing timber. It is made heavy, with a thinnish blade, the taper of the *bit* being

on one side, so that the flat part goes against the timber. The handle is bent or crooked to keep the knuckles from grazing the wood.

Broadcloth.—In manufacturing, a wide and superior article of woolen cloth, plain or twilled, and dyed in the wool or the piece. A cloth not over 20 inches is called a *narrow cloth*. It is folded lengthwise in the piece.

Broad Gauge.—In railway engineering, a distance between rails over $56\frac{1}{2}$ inches. The width of 4 feet $8\frac{1}{2}$ inches was adopted by Stephenson and is the gauge almost universally used.

Broad Tool.—In masonry, a stone mason's chisel which has an edge three and one half inches wide. It is used for finish dressing. The previous tools are the *point* or punch, *inch tool*, and *boaster*,—two inches wide.

Prob.—1. In mining, a short thick timber used to prop the coal while being undercut.

2. In carpentry, etc., a spike driven alongside the abutment of a beam and shore, or of a post on a sill, to prevent slipping.

Broil.—A shop term for a tumult; noisy quarrel, or a disturbance; a brawl; contention; discord.

Broken.—1. Separated into parts or pieces by violence; divided into fragments; as, a broken chain or rope.

2. Disconnected; not continuous; also rough, uneven, as, a broken surface.

3. Fractured; cracked; sundered; strained apart, as a broken reed.

Broken Glass.—In a brass foundry a small amount of glass is frequently thrown on the surface of the molten brass while yet in the crucible, in order to prevent oxidation from taking place.

Bromide.—In chemistry, a compound of bromine with a more positive radical; a salt of *hydrobromic acid*.

Bromine.—In chemistry, one of the elements related in its chemical qualities to *chlorine* and *iodine*. It is a deep reddish brown liquid of a very disagreeable odor, emitting a brownish vapor at the ordinary temperature. In combination it is found in minute quantities in sea water and in many saline springs. It occurs also in the mineral *bromyrite*.

Bronze.—1. A varying alloy of copper and tin, with occasionally zinc or lead added. The copper varies from 80 to 90 per cent. and the tin from 10 to 20 per cent. The greater proportion of tin makes a harder metal but decreases the tensile strength.

2. An alloy, similar in composition to that of tools found in the Pyramids of Ghizeh, and used for the machinery of torpedo boat destroyers, having 89 per cent. copper, 10 tin, and 1 zinc.

3. Also *gun-metal*.

Bronze Powder.—Fine pulverized metal, or powder having a metallic base, applied to the surface of paper, leather, and other materials, for imparting a metallic color and lustre.

Bronzing Liquid.—A recipe for this material is as follows: mix together one oz. sulphate of copper; one oz. sweet spirits of niter; one pint of water. In three or four days it will be ready for use.

Broom.—1. An implement for sweeping floors, etc., commonly made of panicles or top of broom corn, bound together or attached to a long handle; so called because originally made of the twigs of the broom.

2. In tile driving, when a pile is driven, after having reached rock, it generally splits at the bottom; and spreads out, resembling the common broom, hence is so called.

3. In a foundry, a large oblong wire brush, used for sweeping the sand from iron and steel castings.

Brow.—The edge or projecting upper part of a steep place, as, the brow of a precipice; the brow of a hill.

Brow Beating.—The act of bearing down, abashing, or disconcerting; as to *browbeat* witnesses.

Brown.—1. A composite color produced by mixing orange and black, or red, black and yellow. Great variation in shade is possible by varying the proportion of the constituents.

2. To give a bright brown color to, as to gun barrels, by forming a thin coat of oxide on their surface.

Brown and Sharpe Gauge.—The American standard wire gauge. The range of diameters measured by this gauge is from number 40 (= .00314 inch) to number 0000 (= .46 inch), the gauge numbers descending from 40 to 1 thence 0 to 0000. Like other standards, the gauge number decreases as the diameter increases.

Brown Coal.—Mineral coal retaining the texture of wood from which it was

formed. It is of more recent origin than the anthracite and bituminous coal. Called also *wood coal*.

Brown Hæmatite.—In minerals, a hydrated oxide of iron embracing ores widely differing both in appearance and quality. They receive different specific names in different districts but all agree in being composed essentially of *peroxide of iron and water*. Also called *Limonite*.

Browning.—1. A process by which the surfaces of articles of iron acquire a shining brown luster, this may be produced by chloride of antimony.

2. In masonry, a smooth coat of brown mortar, usually the *second coat* and the preparation for the *finishing coat* of plaster.

Brown Paper.—A coarse kind of wrapping paper, which is made from unbleached material such as junk, hemp, refuse flax, etc. It is made of various qualities, from *manilla* to *straw*.

Brown Stone.—A dark brown *sand-stone* much used as a building stone.

Bruising Mill.—In milling, a hand mill in which grain for feed, malt for brewing, and flax seed for pressing, are coarsely ground. It consists of two cast iron rollers mounted on a strong frame, and so arranged that grain is carried between them and crushed more or less according to the degree to which the rollers are tightened up by the hand screw at the end of the frame.

Bruit.—A shop term meaning to report; to *noise abroad*.

Brunei, Isambard Kingdom.—Born 1806, died 1859. An English engineer. His first experience was with his father in an effort to construct the Thames tunnel; in 1829 he submitted designs for suspension bridges and several were built from his plans; in 1833 he was engineer for the construction of the Great Western Railway, but he is best known as the designer and builder of the Great Western, the first steamship for regular trans-Atlantic service (1838); in 1845 he built the Great Britain, the first ocean steamship with a screw propeller, and in 1858 the Great Eastern, for many years the largest vessel in the world.

Brunt.—The force of a blow, shock, collision.

Brush.—An article composed of bristles, hairs, or other like material, set in a suitable back or handle as of wood, bone,

or ivory, and used for various purposes, as in removing dust, laying on colors, etc. Brushes have different shapes and names according to their use, as clothes brush, *paint brush*, *wire brush*, etc.

Brush Wheel.—1. A wheel without teeth, sometimes used in light machinery to turn a similar one, by means of bristles, or something brush-like, or soft, as cloth or buff-leather, attached to the circumference.

2. A circular revolving brush used by turners, silversmiths, etc., for polishing.

B. T. U.—In mechanics, the abbreviation of British thermal unit.

Buck.—1. In mining, to break ore into fragments with a hammer, crusher or grinder. This is subsequent to the operations of *spalling*, *cobbing* and *sorting*.

2. In bleaching, the lye or suds in which clothes are bleached.

3. A frame on which firewood is sawed; as, a *buck saw*.

Buckboard.—A four-wheeled vehicle, in which a long elastic frame is used in place of a body-spring, etc. A buckboard always has one, sometimes two, seats.

Bucket.—1.—A vessel for drawing water from a well; a *pail* for carrying water or other liquids.

2. A receptacle on an elevator for the lifting of loose material; as grain.

3. A *scoop* used in excavating or dredging.

4. One of the compartments formed on the circumference of a water wheel, into which the water rushes, causing the wheel to revolve.

5. A pump-piston, which has valve passages through it for the fluid, as distinguished from a solid piston or from a plunger.

Bucket Dredger.—Also known as ladder dredger; one in which an endless chain of scoops or buckets traveling over a ladder, which can be adjusted within certain limits of depth and width, are employed to excavate navigable channels in rivers and harbors. The vessel, whether the ladder is mounted amidships or on the side, can always dredge her own flotation; the plant frequently being driven off the propelling engines by a clutch.

Bucket Engine.—In civil engineering, a machine to utilize a stream of water which has considerable fall and but moderate quantity. It consists of a series of buckets attached to an endless chain which runs over sprocket wheels, from one or both of which power is obtained. The water flows into each bucket after passing the summit, and is discharged as each bucket reaches the lowest part of its course.

Bucket Pump.—A common type, which is fitted with a bucket or piston having valves through it for the passage of the fluid lifted. A bucket-pump usually has both foot and head valves as well as those in the bucket, but either one may be omitted without impairing the efficiency of the apparatus.

Bucket Valve.—Valves fitted in the bucket of a single acting pump; often the term is applied to those valves in the air pump of a surface condensing engine. These are usually of phosphor bronze or else vulcanized fiber.

Bucking.—1. In textile industries, steeping fabrics in an alkaline bath.

2. In mining, the pulverizing or crushing of ore by hand.

Bucking Iron.—A flat faced hammer for pulverizing ore.

Bucking Kier.—In textile manufactures, an iron or steel boiler in which cotton, thread, etc., is bleached by boiling under pressure in a solution of caustic soda or lime. Also termed *buckwing kier*.

Buckle.—1. An instrument, usually of metal, consisting of a rim with a movable tongue or catch, used for fastening things together, as parts of a harness, by means of a strap passing through the rim, and pierced by the tongue.

2. In engineering, to curve or assume a bent appearance where there should be a flat surface, as through unequal contraction of a casting on cooling.

3. A permanent set or twist in any material that should be flat.

Buckle Plate.—In structural work, a form of iron or steel plates for flooring, having a slight convexity in the middle and a flat rim round the edge, called the *fillet*. They are usually square or oblong, and are laid upon iron beams or girders, *convexity upwards*.

Buckstaves.—The cast iron plates which form the outer casings of reverberatory and other furnaces, and which are supported by the bolts passing from one side to the other.

Buckwheat Huller.—A form of mill, or an ordinary grinding mill with a particular dress and set of stones, adapted to remove the hull from the grains of buckwheat, preparatory to grinding the remaining portion into flour.

Buddle.—In mining, a crude type of machine for concentrating fine sands or slimes, in which the sediment from the ore bearing water is continually brushed level to insure equal action.

Budge.—To move off; to stir; to walk away.

Budget.—A sack or bag with its contents; hence a stock or store; an accumulation; as, a budget of inventions.

Buff.—A leather covered wheel, revolving at high speed, with which metals are polished by the aid of fine emery, rouge or other abrasive or polishing agent.

Buffalo.—In cotton manufactures, a leather hamper in which bobbins are transported from one part of the mill to another.

Buffer Plate.—An iron plate with which the buffer beam is faced and through which the buffer shank passes.

Buffers.—Contrivances at the ends of railway vehicles to minimize shock; consisting of plungers working in a tube, and gaining elasticity from springs.

Buffet.—1. In building, a cupboard or set of shelves, either movable or fixed, at one side of a room, for the display of plate, china, etc.; a side board.

2. A counter for refreshments; a restaurant at a railroad station, or place of public gathering.

3. A blow with the hand; a blow from any source, or that which affects like a blow, as the violence of the wind or waves.

Buffet Car.—A railroad passenger car which is provided with a *buffet*, or eating tables, to accommodate the passengers on the train.

Buffing.—1. A process by which the grain or hair side of leather is removed; principally effected by power.

2. The art or process of polishing metals by the aid of *buff-wheels*, or discs mounted upon a rapidly revolving spindle. These discs were originally made of buff leather, hence the name, but muslin, flannel, etc., are also employed.

Buffing Lathe.—A machine used in polishing by buff wheels; known also as a *polishing bob*.

Buffing Slicker.—A tool which the carrier uses to take light shavings off leather and bring it to a smooth surface. The slicker is a rectangular piece of steel with a grooved end, thus providing two very keen cutting edges; the handle is to the tool like the cross-bar to a T, the method of employment being to lay the slicker flat on the leather, and push it away from the operator, each edge being used in turn.

Buff Leather.—Leather prepared by oil-tanning from heavy hides, which have had their grain or hair side removed, either by hand or by the buffing machine.

Buff Stick.—A tool used to remove old emery and glue from polishing wheels, made by applying alternate layers of hot glue and No. 40 to No. 60 emery to a stick of wood until a solid form of emery is made.

Buff Wheel.—A wheel of wood or other material, covered with leather, and used in polishing metals, glass, etc. The surface is plied with material of coarse or fine quality according to the character and condition of the work, each buff wheel always having its own grade of polishing powder, be it emery, rotten stone, tripoli, crocus, rouge, putty powder, etc.

Buggy Plow.—One having usually several plows attached to a single frame, and having a seat for the plowman, who rides and drives.

Buhlwork.—The term is corrupted from Boule, the name of the inventor, and refers to any two materials of contrasted colors inlaid by the saw. Two pieces of veneer of different colors are scraped and glued together, with an overlaid paper on which the design is traced. The pattern is cut out with a sort of fret saw, and then the piece cut out of the dark veneer is glued into the corresponding opening of the light veneer, and vice versa. Also known as *marquetry*.

Buhr.—A coarse, flinty, cavernous stone, whose cellular texture makes it highly suitable for millstones. France and Germany yield the buhr stone. The separate blocks which are hooped together to form a buhr stone are known as *panes*. The French buhrs are from a quarry near Paris, where the stratum is about three millstones thick. It is a porous silicious stone of exceeding hardness.

Build.—1. To erect or construct, as an edifice or fabric of any kind; to form by uniting materials into a regular structure; to fabricate, to raise, to make.

2 To raise or place on a foundation; to form, establish, or produce by using appropriate means.

3. To exercise the art, or practice the business of building.

Builder's Jack.—A kind of scaffold which is supported on a window-sill and against the wall, and extends outwardly, to enable a workman to stand outside while repairing or painting.

Builder's Measurement.—In navigation, the shipbuilders' system of computing 'tonnage'; giving results about double the legal or registered tonnage.

Building.—1. The act of erecting a structure of any kind, from any material.

2. The act or trade of erecting structures consisting principally of brick, stone or concrete, such as houses, business and manufacturing premises, and public edifices, etc.

3. The structure or edifice thus built.

Building Motion.—In spinning, the contrivance regulating the motion of the traverse rail so that the yarn or roving is laid and wound evenly on the *bobbin*.

Building Mover.—A heavy truck on rollers or wide track wheels, used in moving houses. The building rests on a cross bolster, which is supported by two trucks with three rollers each.

Building Paper.—A coarse paper used in the building trade for deafening floors, keeping out wind, etc., sometimes called *felt paper*.

Building Stone.—In architecture and civil engineering, the stones used in buildings and construction work according to their qualities, the nature of the building or construction, also the possibilities of quarrying and transportation, and the localities of the work which require the stone. Limestone, sandstone, granite, marble, and basalt are the principal kinds used.

Building-up.—1. In pattern making, patterns are said to be built up when they are constructed by laying several courses of segments one above the other.

2. In iron forging, parts of wrought iron and steel are *built up* by the piling of small bars. When numerous pieces are welded together, building up is distinguished from *drawing down*, *up setting* or otherwise manipulating in a single piece.

Built Beam.—In carpentry, a compound beam made of a number of planks, or thin, deep beams, laid parallel and secured together.

Built Rib.—In carpentry, an arched beam made of parallel planks laid edgewise and bolted together.

Built-up.—Composed of different parts firmly united together instead of being made entirely from one piece. Wrought iron forgings are frequently welded from many small pieces, to improve the fibre, one bar in the pile being laid at right angles to the next. Wooden patterns are usually composed of small pieces of wood glued together, to prevent warping. Large shafts, etc., are generally built up of separate parts, owing to the difficulty of insuring soundness with large masses, and also the elimination of chances of a small defect in one piece ruining the whole.

Built-up Crank.—Owing to the difficulty of properly forging the metal in the center of the shaft, marine crank shafts of ten inches and upwards in diameter are usually *built-up*. The webs, journals and crank-pin for each throw being forged separately, rough machined, and then shrunk or hydraulically forced together and keyed up. Afterwards, the whole is finished to the required dimensions in big lathes capable of dealing with enormous weights.

Bulb.—1. In civil engineering, a bead of bulblike cross section, formed along one edge of an iron or steel bar or plate, etc.

2. In instrument making, an expansion or protuberance on a stem or tube as the *bulb* of a thermometer, which may be of any form, as spherical, cylindrical, curved, etc.

Bulb Angles.—In shipbuilding, angle bars with a bulb edge used for frame stiffeners, etc.

Bulb Plate.—A narrow plate having a bulb-like protuberance along one edge; used in conjunction with angles for beams, etc.

Bulge.—To swell out, to bend outward, as a wall when it yields to pressure; to be protuberant, as, the wall bulges.

Bulkhead.—1. A wall or vertical partition in a ship.

2. In mining, a partition closing off a subterranean passage.

Bull Dog.—In metal working, a refractory material used as a lining for the *boshes* of puddling or smelting furnaces. It is a decomposed protosilicate of iron.

Bulldozer.—A heavy power-press, having a horizontal reciprocating ram. It is used to shape angle irons and other details especially for railway car-building, suitable dies being employed.

Bull Engine.—A steam pumping engine for draining mines, in which the cylinder is placed vertically over the shaft, and the spear or pump rod is simply a continuation of the piston-rod.

Bulletin.—A brief statement of facts respecting some passing events; as political or diplomatic occurrences, issued by an authority for the information of the public; a periodical publication, containing the proceedings of a society or union; a notice of importance of a manufacturer to his employees.

Bulletin Board.—A board on which announcements are put, particularly at work rooms, newspaper offices, government buildings, etc.

Bulling.—In rock excavating, parting a piece of loosened rock from its bed by means of exploding gunpowder poured into the fissures.

Bullion.—1. Gold and silver in bars or ingots as distinguished from *specie* or coined money.

2. In smelting, pig lead containing a certain amount of silver, etc., which has not been refined out.

3. A heavy ornamental fringe of silk fabric covered with gold or silver wire.

4. In glass-making, the extreme end of the glass bulb at the end of the blowing-tube. The bulb having assumed a conical form, is rested on a horizontal bar called the *bullion-bar*, to assist in bringing it to the spherical form.

Bull Metal.—An alloy which is used for hydraulic and marine work, and for gun fittings, both in the form of bar and castings. The toughness and ductility of the alloy increase with high temperatures, so that at 400° Fahrenheit the strength of rolled metal is equal to that of mild steel.

Bullnose.—In building, a shaped brick with one rounded corner.

Bullnose Stop.—In building, a shaped brick with part of one corner rounded, the remaining third of the same corner being left sharp.

Bullnose Tool.—A lathe tool used for roughing cuts, with a rounded point much wider and stronger than the ordinary round nosed tool.

Bull Ring.—In engineering, a *distance ring* put on a piston to separate two split rings.

Bull Rope.—In well-boring, an endless rope used to drive the bull wheel of a cable drilling rig, the rope being slipped off the grooved pulley when not actually raising or lowering the string of tools.

Bull's Eye.—1. In building, a small circular opening or window for air or light.

2. A small thick disc of glass inserted in a deck, floor or ship's side, to admit light.

3. A lantern with a thick glass lens on one side, to concentrate the rays of light on any object.

4. In sugar-making, the sight-hole in a vacuum pan.

5. The boss left on a plate of blown glass where it was removed from the blow-pipe.

6. The center of a target.

Bull Wheel.—On revolving derricks, a large wheel at the base of the derrick consisting of a circular flange made of structural T iron to which the boom-swinging ropes are attached.

Bully.—A miners' hammer for striking the drill or boring bar, having an octagonal face, and a square eye.

Bulwark.—1. In civil engineering, a wall or parapet around an enclosure, such as a fortification or battery.

2. In shipbuilding, the sides of a ship above the upper deck.

Bump.—1. To strike heavily or with force; come (against something) with a heavy jolt; to thump.

2. In navigation, the act of striking the stern of the boat in advance with the prow of a boat following.

3. In chemistry, to emit vapor explosively at intervals in boiling.

Bumper Beam.—A strong wooden beam across the ends of a locomotive or tender, to which the bumpers or *buffers* are attached.

Bumpers.—The same as *buffers*; but more properly, the prolongations of the wooden sills of *mineral wagons* which serve the purpose of buffers.

Bumping Post.—A post at the end of a railroad track, braced by having the ends of the rails curved up and attached to it, and firmly stayed from behind, to prevent trains from over-running the line.

Bunch.—1. In mining, the expanded portion of a pipe vein, that is, one which instead of preserving a uniform size, has *contractions and expansions*. A body of ore not continuous like a course; also called a *squat*.

2. In flax manufacturing, three bundles or 180,000 yards of linen yarn.

Bundling Machine.—One for grasping a number of articles into a bundle ready for tying. Machines of this character are used for firewood, and many other articles sold in tied bundles. The handle is adjusted in position to expand the bands or straps for receiving the articles to be bound, when it is drawn down and by a slight turn of the handle, the machine will be locked and the bundle securely held until tied.

Bung.—A large plug or cork for stopping the hole in the side of a cask through which it is filled.

Bung Starter.—In cooperage, a *flogger* or bat used to start the bung of a cask by beating on the bulge alongside of the bung.

Bunk.—1. A wooden case or box, which serves for a seat in day time or a bed at night.

2. A piece of wood placed on a lumberman's sled to sustain the end of heavy timbers.

Bunker.—1. A sort of chest or box, as in a window, the lid of which serves for a seat.

2. A large bin or similar receptacle; as, a coal bunker.

Bunning.—In mining, a platform in a stope on which the rubbish is thrown.

Bunsen Burner.—A form of gas-burner used for stoves, furnaces, and laboratory purposes, where a hot, non-luminous flame is required. Its essential feature consists in drawing in a sufficient supply of air to promote complete combustion and mixing it with the gas beforehand. This is effected by means of a nozzle within a short tube, the jet of gas, rushing from this nozzle towards the burner at the far end of the tube, sucks in the air through openings in the side of the tube, and the gas and air mingle on their way to the burner.

Bunting.—A fine, soft cloth woven from worsted, of which flags are made.

Bunting Irons.—The glass-blower's pipe.

Buoy.—In navigation, a floating body, generally cylindrical or conical in shape, painted some distinctive color, and secured to the bottom by a heavy anchor; it serves to mark dangers or the confines of a channel.

Buoyancy.—1. In physics, the power or tendency of a liquid or gas to keep an object afloat.

2. Upward pressure exerted upon a floating body by a fluid.

Bur or Burr.—1. In machinery, a circular saw or toothed drum used on a mandrel between the centers of a lathe.

2. In metal working, a roughness left on the metal by a cutting tool, such as a graver or turning chisel. The bur of a graver is removed by a scraper, that of a lathe-tool by a burnisher or in the polishing process. A bur is purposely made on a currier's knife and a comb maker's file, and in each case constitutes the cutting edge.

3. In manufacturing of the knitting machine, a wheel with thin plates or projections inclined to the axis of the bur, and used to depress the thread between the needles and below the beads; it is then called a *sinker*. It becomes a *knocker* off when it raises the loops over the top of the needle.

4. A fluted reaming tool.

5. A triangular chisel.

6. In structural iron work, a *planchet* driven out of a sheet of metal by a punch; a *washer* placed on the small end of a rivet before the end is swaged down.

7. The jet, sprue, or neck of a bullet, cast from lead.

Burden.—1. That which is borne or carried; a load; to encumber with freight.

2. In mining, the tops or heads of stream work which lie over the stream of tin.

3. In metallurgy, the proportion of ore and flux to fuel in the charge of a blast furnace.

Bureau.—1. In cabinet making, a desk or writing table with drawers and pigeon holes for papers.

2. In administration, a department of public business requiring a force of clerks; the body of officials in a department who labor under the direction of a chief.

Burette.—A laboratory instrument, consisting of a graduated glass tube with a tap or cock of some sort in its bottom. The burette is mounted on a stand over some vessel into which it is desired to discharge the measured quantity of liquid.

Burglar Alarm.—A device attached to a door or window, to cause an alarm when opened from outside.

Burin.—A tool with a lozenge-shaped point, used in engraving; a *graver*.

Burlap.—A coarse stuff made of jute, flax, hemp, or manila, used for wrapping grain, merchandise, etc.; also a finer kind used for curtains and in upholstery.

Burling Iron.—In textile manufactures, a sort of tweezers used to burl cloth, that is, to remove knots, lumps, burls or loose ends.

Burner.—A device for controlling the flame from the combustion of a liquid fuel or gas; specifically, a tip for a gas jet, by means of which a proper shape is given to the flame and steadiness of burning is assured. Also applied to an atomizer.

Burnettizing.—In construction work, the process of a special preparation for preserving timber; as, by a solution of chloride of zinc according to the formula of its inventor, Burnett.

Burning.—In blacksmithing, wrought iron becomes burned when it is allowed to remain in the fire too long at a temperature equal to or greater than that of the welding heat. It can then barely be utilized by repeated reheatings and hammerings, but is best discarded.

Burning Chamber.—The hottest chamber in cement kilns, where the incorporated materials are burnt into *clinker*; the heat from this chamber passes over the *slurry* in the drying chamber, thus economizing fuel.

Burning Glass.—A lens used to concentrate the rays of the sun at its focal point, thus obtaining sufficient heat to ignite tinder or dry wood.

Burning Off.—The removal of old paint by means of a torch or *blow* lamp, preparatory to coating the surface anew.

Burning On.—In foundry work, the process of piecing iron on to a defective casting. A mold of the shape of the desired addition is affixed to the casting, and, being provided with gates at the top and side, molten metal is poured through the mold until test rods show the casting about to melt; the side gate is then plugged and the metal is left to adhere and cool.

Burnish.—To make smooth and bright; to polish; specifically, to polish by rubbing with something hard and smooth, without scraping or removing any thing from the surface; as, to burnish brass or silver.

Burnisher.—1. One who burnishes.

2. A tool with a hard, smooth, rounded end or surface of steel, ivory, or agate, used in smoothing or polishing by rubbing, as metallic articles, etc.

3. A tool used by engravers to soften the effect of a harsh line.

Burnt Sand.—In moulding, the fine sand which adheres to castings before they are cleaned; it is afterwards used as a parting sand.

Burr.—1. A rough unhewn stone.

2. A term applied to certain stones of French origin, whose dressed surfaces form a *buhr* or cutting texture, rendering them peculiarly adaptable for mill-stones.

Burring Machine.—A wool-picker; a machine for cleaning wool and removing the burrs from it before it goes to the carding machine.

Burring Reamer.—In engineering, a fluted countersink used to remove the burrs from the edges of drilled holes.

Burrock.—In civil engineering, a small weir or dam in a river to direct the stream to another course than the one originally intended.

Burr Pump.—In navigation, a form of bilge-water pump in which a cup shaped cone of leather is nailed by a disk burr on the end of a pump rod, the one collapsing as it is depressed, and expanding

by the weight of the column of water as it is raised.

Burrs.—Masses of bricks which have become fused together during burning; they are thus rendered unsuitable for building purposes, but may be broken up for concrete, etc.

Bursting Charge.—In mining, a small charge of fine powder, placed in contact with a charge of coarse powder to ensure the ignition of the latter. It is usually fired by electricity.

Bush.—A hollow cylinder or annulus of brass or gun metal, which affords bearing surface for a shaft or spindle. The bush is usually forced into its seat, and is non-adjustable; for many applications it is preferable to *split bearings*.

Bushel.—A measure of capacity. The standard bushel of the United States contains 2150.42 cubic inches; and the Imperial bushel of Great Britain contains 2218.192 cubic inches.

Bush Hammer.—A tool employed by stone masons to give a finished surface to granites and other hard stones, the face of the hammer being composed of a number of sharp pyramidal points.

Bushing.—1. A pipe fitting for the purpose of connecting a pipe with a fitting of larger size, being a hollow plug with internal and external threads to suit the different diameters.

2. A bush; a brass or bronze liner forced into a bored hole to provide a better wearing surface or one that may be easily renewed when worn.

Business.—A pursuit or occupation, or that which engages the time, attention, or labor of any one as his principal concern or interest, whether for a longer or shorter time; constant employment; regular occupation.

Bus Pipe.—A manifold pipe fitted to the cylinder of an automobile.

Butt.—1. In leather manufacture, the best part of a tanned hide consisting of the back after the softer and more irregular pieces have been cut off. The *butt* is used, because of its uniform thickness, for *sole-leathers*, *belting*, etc.

2. A cask containing 126 U. S. or old wine gallons. It is no longer legal measure in England; there it is taken as 110 Imperial gallons.

3. The thick or heavy end of anything; as, the *butt* of a firearm; the thick end of the stock.

4. To abut against; or parts which are in butting contact.

Butter.—In wood working, a machine for sawing off the ends of boards, to render them square and to remove faulty portions. In the large saw mills of the lumber regions, double butters are used one saw being permanent and the other adjustable by a spline on a grooved mandrel, to adapt it for boards of varying lengths.

Butterfly Valve.—1. A double clack-valve with the joint between the two semi-circular pieces like a common hinge.

2. A circular valve working on a central axis like the common throttle of a marine engine.

Butternut.—A wood, so called on account of the oil in its nut. It is frequently called the *white walnut*, and resembles the black walnut. The wood is soft but takes a high polish, and is used for interior work, it being fine, close grained, and light colored, turning yellow on exposure.

Butterworker.—An implement used for pressing and rolling butter in order to free it of buttermilk. There are two kinds: (a) a fluted roller working in a board or bowl; (b) a conical roller on a slanting board, which permits the buttermilk to run off.

Butt Hinge.—A jointed fastening for a door, etc., consisting of two metal leaves, the ends of which interlock, and are pierced with a common *pin* upon which the hinge revolves. This type of hinge is attached to the butting surfaces of door and post, hence its name.

Butting Saw.—A cross cut saw attached to a stock at one end, and used for butting logs on the carriage of a saw-mill. Many logs are brought to the mill with the slanting *kerf* given by the axe in felling or logging. To butt a log is to cut or saw it off square at the end, so that it may lie safely upon the rabbet of the head block in any position and be readily held by the dogs. The action of this saw is that of a *chug-saw*.

Butt Joint.—In boiler-making, etc., the formation of riveted joints so that the two plates to be united *butt* together or meet edge to edge instead of overlapping. Internal and external reinforcing plates, known variously as *butt straps*, *covering plates*, or *welt strips*, are laid over the joint and the three thicknesses are riveted together.

Butt Measurement.—In iron work, the measurement of a dimension by thrusting one end of a rule against the portion whence the measurement is taken. The term is employed to distinguish it from measurements taken with trammels, compasses, or dividers, or measurements set off by marking from the rule divisions themselves.

Butt-miter.—The joint where the ends of two pieces of material, more especially of moulding, butt together at an angle.

Button.—1. In carpentry, a small piece of wood or metal *suiveled* by a screw through the middle and used as fastening for a door or gate.

2. In builder's hardware, a knob on a sliding bolt.

2. In metallurgy, a globule of metal remaining in the *cupel* after fusion.

Button Head.—A term occasionally applied to the hemispherical head of a rivet, screw, etc., the term *snap-head* or *snap-point* being more general.

Button Headed Screws.—In machinist work, small set or attachment screws whose heads are hemispherical in outline. They are driven in with a screw driver.

Button Hole Machine.—A sewing machine, or attachment thereto, for the purpose of sewing around button holes with the necessary loop stitch.

Buttress Thread.—A special kind of V-thread employed where the strain on the nut comes in one direction only, the slope toward the strain being almost vertical, thus opposing great resistance to the thrust against the nut.

Butt Riveting.—In structural iron work, and boiler-making, when the edges of two plates are brought one against the other, and are riveted into a covering plate or strip embracing the two. The term is used to distinguish it from *lap riveting*.

Butt Strap.—A covering plate used in connection with a riveted joint in which the plates to be united meet edge to edge, i. e., flush.

Butt Weld.—A welded joint in which the two edges to be united are simply abutted together, after previous bumping up, or upsetting, as distinguished from a *lap* or *scarf weld*.

Butt Welded Tubes.—Tubes whose joints are simply abutted in welding, as distinguished from *lap welded tubes*.

Butty.—In mining, one who mines by contract, at so much per ton of coal or ore.

Buzzer.—In gas engines, a name sometimes applied to the *trembler* of a jump-spark ignition.

Buzz Saw.—A circular saw so called from the sound it makes when running at full speed.

B. W. G.—An abbreviation of Birmingham Wire Gauge.

By-pass.—1. A small valve on a gas pipe serving as a pilot valve.

2. A valve intended to open an alternative passage to fluids passing through a system of piping, in order that some fitting or appliance on the customary route may be cleaned, adjusted or repaired.

3. On compound marine engines, a valve admitting steam from the main steam pipe to the receiver; used in starting when a high pressure engine is on a dead center.

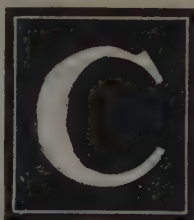
By-pass Valve.—On locomotive cylinder steam chests, a small automatic valve which admits air into the steam chest when steam is shut off, so as to prevent a vacuum being formed by the moving pistons. Also called *vacuum relief valve*.

Bystander.—One who stands near; a spectator; one who has no concern with the business transacting.

By-wash.—A channel to carry off the surplus water from a reservoir, or the discharge by overflow of the *waste weir* at a dam.

Byword.—A common saying; a proverb; a nickname, especially one given in contempt.

By-work.—Work aside from regular work, subordinate or secondary business.



C.—1. The third letter of the English alphabet.

2. As a numeral, C stands for Latin *centum* or 100, CC for 200, etc.

3. In structural and mechanical designing, C stands for center.

Cab.—The screen or shelter over the foot-plate of a locomotive protecting the engine-crew, etc.

Cabbling.—In metal work, the process of breaking up the flat masses into which wrought iron is first hammered, in order that the pieces may be reheated and wrought into bar iron.

Cab Fittings.—In or on a locomotive, a collective term applied to such details as the door and its furniture, windows, seat, hand rails, etc. Also to the various boiler-mountings and appliances, operating-lever and the like, placed within the cab or upon the boiler head immediately under the control of the enginemen.

Cabin.—1. In building, a cottage or small house; a hut.

2. In navigation, a room in a ship for officers or passengers; the general saloon in a steamship.

Cabinet.—A chest or box with drawers and doors; any closed place where things of value are deposited for safe keeping.

Cabinet File.—A smooth single cut file, half round in section, used by joiners and cabinet makers.

Cabinet Maker.—In carpentry, one whose occupation is to make decorative pieces of furniture or other choice articles of household use.

Cabinet Nest.—In designing, a palette containing several independent saucers, circular in plan, and fitting closely one above another, to prevent drying up of the ink or color when not required for immediate use.

Cable.—1. In navigation, a large, strong chain or rope that is attached to an anchor; a marine measure of distance equalling one-tenth of a mile.

2. In civil engineering, the strongest cluster of wires for supporting the roadway of a suspension bridge.

3. In mechanical engineering, the wire rope of a cable way or a mechanical incline hoist; the wire rope of a cable car system.

Cable Brake.—A bicycle brake depending for its action upon the tightening of a small chain or steel cord which encircles the hub.

Cable Chain.—A term occasionally employed by hardware dealers to denote chains made of welded links, either close link or stud, to distinguish them from built up chains, with detachable links.

Cable Drill.—The usual type of well-boring apparatus, used in Ohio and Pennsylvania, in which the drilling tools are suspended at the end of a cable or rope, operated by a walking-beam. This system is noted for its rapidity, as the tools are quickly raised from the hole or lowered into it, and numerous clever appliances have been evolved for use with it.

Cable Hook.—1. A hook for attachment to the messenger by which the cable is hauled in on a man-of-war or other ship, having a large number of hands, without having recourse to the capstan. It may also be attached to a hawser for under running the cable.

2. A hook by which the cable is handled. Each seaman has a hook in lifting up the cable or to assist in packing it in tiers.

Cable-laid.—A rope composed of three common ropes instead of strands.

Cable Road.—A line in which power is derived from an endless cable actuated by a central stationary engine and running over pulleys between the rails or in a conduit beneath them; the cars are provided with a gripping lever to connect with the running cable, or occasionally are seized to it by a rope.

Cable Stopper.—In navigation, a device to stop the paying out of a submarine cable. A pair of jaws slide on the rail, being moved simultaneously by an eccentrically slotted wheel and lever.

Cableway Engine.—In power transmission, a type of hoisting engine, used for operating cable ways.

Cabling.—In architecture, a round moulding, frequently used in the flutes of columns, pilasters, etc.

Caboose.—1. A type of box car which has accommodation for a train crew with bunks, cooking stove, etc.; it is the usual American practice to have one attached to each freight train.

2. A term for the cook's galley on small craft.

Cacao.—A small evergreen tree of South America and the West Indies. Its fruit contains an edible pulp, enclosing seeds about the size of an almond from which cocoa, chocolate, and broma are prepared.

Cacao Mill.—A mill for grinding the cacao bean, to reduce it to the condition of flake cacao; this differs from chocolate in being ground with a portion of its hull, instead of being carefully hulled before grinding. It is mixed in the hopper with flour, sugar, etc., and passed through a number of steel mills resembling paint mills, by which the bean is reduced and the ingredients intimately incorporated therewith by means of friction, heat, and the oil evolved from the bean.

Cache.—To hide; to conceal. A hole in the ground, or a hiding place for concealing and preserving provisions when it is inconvenient to carry them on exploring expeditions.

Cadastral.—Pertaining to an accurate survey and registration of titles and boundaries of real property both private and official; hence, a minute and official survey. The more common usage of the term applies to *surveying and mapping*.

Cadmium.—A tin-white metal, much resembling zinc in its properties and compounds, and occurring with zinc ores as a sulphide. It burns with a bright flame, forming a brown oxide. The sulphide of cadmium is of a bright yellow color, and affords a valuable pigment, *cadmium yellow*.

Cage.—1. The receptacle in which men and materials are raised or lowered in a shaft by means of winding or hoisting gear. In coal mines, the cage has two or more stages or platforms for the reception of the miners and the wagons conveying the excavated minerals. One cage descending usually balances the other ascending.

2. The arrangement of curved bars of woven wire intended to prevent a ball valve from rising too far from its seat, returning it to its proper position at each lift.

Cairn.—A heap of stones, generally conical in shape. Formerly erected over a tomb or to commemorate some event; frequently used to mark a boundary, frontier line, or as a landmark.

Caisson.—1. A box or similar receptacle, from the French *caisse*, a chest.

2. An air and water-tight structure used to seal the openings of dry docks, instead of gates. It is floated to its desired position, moored, and sufficient water admitted to its lower compartment to sink it into a groove, the external pressure of water outside the empty dock retaining it in place.

3. A device employed in making foundations in treacherous soil; as, of a river-bed or soft ground. A reinforced ring of steel plates is erected upon the proposed site, and as it sinks into the ground, the material is excavated from underneath and removed through a lock at the upper end. The excavation is conducted in compressed air to exclude water. As the caisson sinks, fresh rings are added.

Caisson Disease.—A complaint which attacks persons leaving the compressed air within a caisson for the ordinary atmosphere. The vessels of the body having become charged with compressed air, a sudden relaxation of the outward pressure causes internal lesions and dreadful cramping pains, which cause the disease to be known as "the bends." The only preventive is a proper interval of time spent within the *air-lock*, both entering and leaving, so that the body may get gradually used to changes of pressure.

Cake Mill.—A machine for breaking up oil cake into small pieces for foddering. The cake is fed into a narrow hopper and broken between toothed rolls, the fragments being delivered through a perforated spout which separates the dust.

Cake Press.—In vegetable oil manufacture, a hydraulic press by which the heated *meal* is treated to express the oil, and compress the residue into the well known oil cakes for cattle feeding.

Caking Coal.—Coal which gives off abundance of gas and thereupon coalesces or hardens into a mass. The coals principally used in gas making are of this class; as, bituminous coal.

Calamine.—The ore of zinc. It is zinc carbonate consisting of 64.8 zinc oxide and 35.2 per cent. carbon dioxide. It is found in many parts of Great Britain and the United States.

Calcar.—1. A fritting furnace, or a furnace in a glass works where the materials for a *frit* are melted. Sometimes termed *colcar* by mistake.

2. An annealing furnace in *metallurgy*.

Calcareous.—Containing, or possessing the attributes of lime.

Calcination.—To reduce to a friable state by heat. During the heating or roasting processes, certain gases or other volatile cementing materials are driven off, thus reducing the mass to a powdery or soft form.

Calceine.—1. To reduce to a powder, or to a friable state, by the action of heat; to expel volatile matter from, by means of heat, as carbonic acid from limestone, and thus, usually, to produce disintegration; as, to *calceine* bones.

2. To oxidize, as a metal by the action of heat.

Calcing Kiln.—A furnace for reducing by calcination, the flints and other refractory materials used in *china* manufacture.

Calcite.—A crystallized form of calcium carbonate, constituting the stalactites and stalagmites in caves. *Iceland spar* is a very pure variety. As a gangue metal, calcite occurs very commonly in metalliferous veins.

Calcium.—A rare white metal, rather harder than lead, having a specific gravity of 1.85 and melting at 189° F. Its various compounds described under their proper headings, constitute many of the rocks composing the earth's crust, or are in daily use in the arts, as *lime*, *limestone*, *chalk* and *chloride of lime*.

Calcium Carbide.—A compound of carbon and calcium formed in the electric furnace from limestone or chalk and charcoal or coke. When pure it has golden crystals, the commercial substance being brownish and hard; it is non-inflammable, and insoluble in most acids. The principal use of this carbide is for the generation of *acetylene*, in conjunction with water.

Calcium Carbonate.—The chief natural compound of calcium (*lime*), occurring as *Iceland spar* in its purest form, and otherwise as marble, chalk, limestone and coral. The shells of sea fish and birds' eggs consist chiefly of this material. It is extensively employed as a flux in metallurgy.

Calcium Chloride.—In chemistry, is prepared from carbonate by dissolving in hydrochloric acid, and evaporating the solution. After having an exposure to the air for some time, it becomes liquid and dissolves itself. On account of its oxidizing properties, it is used as *bleaching powder* and as a *disinfectant*.

Calcium Chloride Brine.—In refrigeration, is used preferably to a solution of sodium chloride (common salt), as it is a more energetic moisture absorber than the latter, and does not rust the tanks or coils. A 20 per cent. solution is the usual strength, and a temperature of 8° to 18° F. is maintained, with an average of 14° F.

Calcium Sulphate.—Occurs in nature as *alabaster* and as *gypsum*. When the latter is heated for some time to a temperature of about 275° Fahr. its contained water of crystallization is expelled, forming commercial sulphate of lime or *plaster of paris*. This material is used to form moulds, etc., for a variety of purposes, being mixed with water to form a paste, which hardens back into gypsum again.

Calculate.—1. To ascertain or determine by mathematical processes, usually by the ordinary rules of arithmetic; to reckon; to estimate; to compute.

2. To plan; to expect; to think.

Calculating Machine.—A machine for performing and registering calculations. The planimeter and the cylindrical slide rule may be classified as calculating machines, as from them numerical results may be ascertained by a mechanical operation; the term is however more frequently applied to such elaborate machines as those employed in compiling census returns, and banking and business tables.

Calculation.—1. The act or process, or the results of calculating; computation; reckoning; estimate.

2. An expectation based on circumstances.

Calculus.—1. Any method of calculating or investigating by the symbols of algebra; a division of higher mathematics.

2. A term commonly used for *infinitesimal calculus* and which includes *differential calculus* and *integral calculus*.

Caldron.—A large kettle or boiler of copper, brass or iron; also spelled *cauldron*.

Calendar.—A system of fixing the order, length and subdivisions of years and months; a schedule or list of things or events classified or arranged according to *dates*.

Calender.—In manufacturing, a machine used to give a smooth and glossy surface to silk, cloth, paper, etc., consisting of a number of rolls, some covered with felt, leather or paper, and others heated by internal steam; thus finishing the goods under the combined influences of heat and great pressure.

Calendering.—In manufacturing, the series of operations (differing according to the goods), of straightening, damping, pressing, stretching, starching, drying, embossing and watering woven goods; including the various processes intervening between the bleaching or dyeing and the packing for market. The whole process gives the goods a glossy surface finish.

Calender Rollers.—In saw-milling, the heavy grooved rollers which feed the timber along to the saws, or to the cutters, in frame saws, and planing machines for wood.

Calf Skin.—The skins of calves are subjected to the preliminary processes of soaking, liming, unhairing and fleshing, and are then steeped in a fermenting solution, after which they are *drenched* in fermenting bran. This softens the skins. The subsequent tanning is carried out in a series of pits containing *oozes* of increasing strength, oak bark being the chief agent. After tanning, the leather is scoured and shaved on the flesh side to make it of uniform thickness. It is oiled before drying, is then coated with soap and mucilage, and polished after re-drying. For shoemaking, the calf is dyed to the desired shade after scouring, dressed with oil and polished by brushing. *Calf-kid* so much used formerly for boot uppers, was dressed with a mixture of alum, salt, flour and egg-yolk; and afterwards dyed black on the grain side.

Calibration.—The exact determination of the indications of a recording instrument by direct comparison with a standard. Thus, before making a test of an engine, the gauges are *calibrated* with a mercurial gauge, etc., and the thermometers compared at all parts of their range with a standard instrument, a scale of differences being noted.

Calibre or Caliber.—1. The size or weight of anything (probably from the Latin *qua libra*, of what weight).

2. The bore or internal diameter of a cylinder, more especially of the barrel of a firearm or cannon, and hence the measure of the *weight* of the projectile. Thus a gun with a bore of 6 inches is said to be of that *calibre*, and fires a projectile weighing 100 lbs., this being the standard for testing armor plate. The length of the bore is also expressed in terms of the calibre; as, the 6" gun in the U. S. Navy has a length of 50 calibres or 25 feet.

Calico.—A cotton cloth in which the warp and filling are alternately interlaced, or what is termed *plain weave*, thus making a strong material and firmly bound.

Calico Printing.—The process of imprinting patterns in colors on textile fabrics, either by means of wooden blocks or by cylinder machines. A representative process known as *madder printing* is to pass the cloth through a rotary press in which it receives impressions from a copper roll, supplied with *mordant*, or a substance having affinity both for the dye-stuff and the fiber.

Calin.—An alloy of lead and tin, used by the Chinese as a lining for tea canisters and boxes, and known in America as *tea lead*.

Caliper Gauge.—In engineering, a standard gauge formed in the shape of a pair of calipers. This type of gauge is

usually made double ended to serve as a limit gauge, one pair of jaws representing the maximum and the other the minimum size.

Caliper Rule.—An engineer's rule upon which slide two legs or arms at right angles to it, these are set by the graduations of the rule and locked by a milled screw, thus affording a convenient gauge for metal plates, boards, etc.

Calipers.—Instruments to measure internal and external diameters or *calibres* of cylindrical pieces; they usually consist of two curved pieces of steel, hinged together with a tight joint at one end, the distance between the *points* representing the measurement taken.

Caliper Square.—A square having a graduated blade and an adjustable tongue. The blade has rule graduations carrying two cross-heads, one of which is adjusted slightly by a nut, the other being movable along the blade. The cross-heads on one side are adapted to the measurement of *interior* diameters or sizes, and the other side, to the measurement of *external* sizes.

Calking.—1. In shipbuilding, the process of filling the seams between planks by driving in oakum. The seam is opened by a reaming iron, driven by a beetle, and the threads of oakum driven in one after another by a calking iron and beetle. It is further compressed by a *horse-iron*, held in one hand and driven by the beetle. The work is then treated with melted pitch.

2. In iron working, the calking consists of striking a chisel, or calking tool with a hammer, making a slight indentation along the seam. The effect of this is to force the edge of one plate hard-against the other and thus fill up any slight crevice between the plates which the rivets failed to close.

3. Tracing with a style the outlines of a print which lies on a colored chalk paper superimposed on a white sheet of paper. By this means, a chalk outline is imparted to the lower paper. It is the principle of the manifold writer. Also called *calquing*.

Calking Chisel.—These are chisels for closing the seams between iron plates, as boiler plates, and are made of different sizes and forms.

Calking Iron.—The chisel-like tool used in calking oakum into the seams of a deck. It is grooved along its edge, thus presenting a concave surface to the yarn in the seam, and stemming it in better than would be the case with a square edge.

Calking Ring.—A ring of wrought iron or mild steel placed between the shell of a boiler or tank, and such cast-iron mountings as manholes, domes, steam chests, safety-valves, etc. This ring is a necessity on account of the impossibility of calking the cast iron itself. When other than circular, this device is known as a *calking strip*.

Calking Tool.—A blunt-ended chisel used by boilermakers to *calk* riveted joints, by driving a portion of the over-lapping edge into the seam, thus rendering it staunch, in a manner akin to calking the seams of a vessel with oakum. The calking tool should be rounded on its edge, as angles tend to set up cracks in the plate, but for finishing a seam during repairs, it is advisable to *hob* or roughen the point, like a mason's bush hammer.

Call.—1. The act of calling; usually with the voice, but often otherwise, as by signs, the sounds of some instrument, or by writing; a summons.

2. In navigation, a whistle or pipe, used by the boatswain and his mate to summon the sailors to duty.

Calliope.—An arrangement of *steam whistles*, tuned to a harmonic scale, with levers and keys so that a tune can be played upon them.

Callous.—Hardened; indurated; unfeeling; unsusceptible.

Calm.—1. To make calm; to render still or quiet; as, the elements; as, to calm the winds.

2. To deliver from agitation or excitement; to still or soothe, as the mind.

Calomel.—In chemistry, mild chloride of mercury, a heavy white substance, insoluble and tasteless. It occurs native as the mineral *horn quicksilver*.

Caloric.—A term applied by *Carnot* to the supposed cause of the phenomena of heat, at the period when heat was assumed to be the manifestation of a substance, *caloric*, latent in all bodies.

Caloric Engine.—A name given to the *hot air* engine first designed by Capt. John Ericsson, the builder of the *Monitor*.

Calorific.—In physics, a term meaning heating; heat producing.

Calorimeter.—An instrument used for measuring the heating power of coal. It consists of a strong steel vessel immersed in water, proper precaution being taken to prevent radiation. One grain of the coal to be tested is placed in a platinum tray within the steel vessel, oxygen gas is introduced under pressure of 20 to 25 atmospheres and the coal ignited by an electric spark. The heat generated causes a rise in the temperature of the water, from which may be calculated the heating power of the coal.

Calorimetry.—The science of *heat measurement*, or of assigning calorific values to fuels.

Calyx Drill.—A rotary well-boring machine of a core-making type, akin to the diamond drill, in which the cutter is made of steel.

Cam.—A revolving disk, usually of a spiral eccentric, or heart-shape, fixed on a shaft; or such other form as to impart to a lever, rod or block in contact with it, such velocity or alternating or *variable motion* as may be required.

Cam-ball Valve.—A valve actuated by a cam on the axis of a ball-lever, so that as the float rises in the cistern, the cam shall press against the stem of the valve and close it against its seat, thus shutting off the supply when a given level has been attained in the cistern, tank or boiler.

Camber.—1. A slightly arched or upwardly convex form; as, a ship's deck-planking; the *camber* or arched curve given to a bridge-span which confers stability.

2. In bricklaying, a wooden strip with one edge carried to a small rise, as of one inch in six feet; used in laying *flat arches*.

Camber of Deck. In shipbuilding, the convexity or rounding up which is given to a deck from side to side, generally one quarter inch per foot.

Cam Chuck.—In *turning*, a profiling device fitted to the saddle of an ordinary lathe, enabling the machine to turn out irregular forms, such as cams. The cutter revolves in the fast headstock, while the work is manipulated on the *rest* of the lathe.

Camel.—A decked and flat-bottomed vessel, adapted for the transportation of heavy weights and of use in the raising of sunken vessels.

Camel's Hair.—1. The hair of the camel used for artists' brushes.

2. In woolen manufacture, sorted hair of the camel, used for spinning yarn for divers purposes.

3. A fabric, composed of alternate hair and wool, used in the weaving of *driving belts*.

Camco.—A carving in relief, like the surface of a coin, the antithesis of *intaglio*, which is like a signet. Properly speaking, a *camco* is a carving on a shell or gem such as agate or onyx, showing two or three layers of color, the material being cut away so as to utilize the different colors in the pattern.

Cameo Glass.—Cased glass, or glass which is composed of two or more thicknesses of various colors, the different layers being cut away to form a design as with a cameo. In modern methods, the different colors are fused upon a previously blown colorless glass globe, and when the pattern is complete, the whole is blown to the desired form in a mould.

Camera.—The instrument used in photography. It consists essentially of a light-tight darkened box, at the front of which is the *lens* which projects the image of the object upon the *sensitized plate* at the back of the camera. An arrangement is made for *focusing*, or varying the distance between the lens and the plate, in order to secure a sharp photograph.

Cam Friction.—That friction existing between a cam and the piece it actuates.

Cam Gear.—A toothed wheel driving a camshaft in an automobile.

Cam Governor.—A controlling device used in connection with Otto-cycle gas-engines: a stepped or differential cam is used giving three or four grades of valve lift; the action of the governor balls slides the roller on to one or another of these cams according to the centrifugal force of the balls.

Camp.—1. The ground or spot on which tents, huts, etc., are erected for shelter, as, for lumbermen, workingmen, etc.

2. A collection of tents, huts, etc., for shelter, commonly arranged in an orderly manner upon the camp-ground, as above.

3. The company or body of persons encamped; as, of surveyors, of lumbermen, of construction workmen, etc.

4. A mound of earth in which potatoes and other vegetables are stored for protection against frost.

Campaign.—In metallurgy, the length of time a blast or other furnace is in operation, expressed as days, months, etc. In other words, the period during which the lining of the stock can last.

Campanile.—A bell-tower usually separate from the main edifice; as, the Campanile at Venice, Italy.

Camp Ceiling.—In architecture, one in which the marginal portion is sloping, following the line of the rafters, while the mid-portion is level.

Camper Beam.—In architecture, a beam which is laid upon the straining beam in a truncated roof, and supports the lead or copper covering of the summit. It has a slope towards each end to carry off the water.

Camphene.—Rectified oil of turpentine, used for burning in lamps, and as a common solvent in varnishes.

Camphor.—A colorless translucent crystalline solid, with a characteristic smell, obtained by distilling the wood of the camphor tree—a native of Japan and Formosa. It is a partially oxidized terpene, melts at 347° F., volatilizes at ordinary temperatures and has a specific gravity of 0.99. It is readily soluble in alcohol, also in 700 volumes of water.

Cam Plate.—An eccentric rotating plate, employed to produce reciprocating motion of an intermittent or irregular character.

Camp Sheet.—In civil engineering, a piling erected at the foot of an embankment to prevent the out-thrust, or the washing away by the current or waves.

Cam Shaft.—A shaft upon which cams are mounted, to drive the valves of an internal combustion engine; also known as *secondary shaft*.

Cam Wheel.—A wheel with a projection or projections either on the periphery or face, adapted to give motion to another object against which it impinges, by sliding contact. Their forms and applications are various, and the actions of the *heart-wheel* and eccentric are substantially similar.

Can.—1. A vessel of small size made of sheet-metal and used for various purposes; it is provided with a spout for pouring out its contents.

2. In textile manufactures, a cylindrical container into which the *sliver* is fed from the carding engine.

Canada Balsam.—A resinous fluid or gum, obtained from the Balsam Fir of North America. It is very viscous and hardens into a clear transparent solid. Canada Balsam has a refractive index about the same as glass, and is therefore used for cementing lenses or prisms together, or for mounting objects on microscope slides.

Canal.—An artificial water-course, particularly one constructed for the passage of boats or vessels.

Canal Lock.—A hydraulic elevator, consisting of two mechanical structures erected across a canal for raising and lowering boats from one level to another.

Can Buoy.—A large floating buoy in the form of a cone.

Cancel.—Cross or deface, as the lines of a writing, or as a word or a figure; to mark out by a cross line; to blot out or obliterate.

Cancellation.—A method of shortening arithmetical problems by rejecting equal factors from the divisor and dividend. The sign of cancellation is an oblique mark drawn across the face of a figure, as 4, 6, 2. Cancellation means leaving out; if there are the same numbers in the numerator and the denominator they are to be omitted.

Candidate.—One who offers himself, or is put forward by others, as a suitable person, an aspirant or contestant for an office, privilege, honor, position or employment.

Candle.—The wicks of modern candles are plaited from cotton and impregnated with a solution of borax and ammonium sulphate, which makes them burn without any ash or causing guttering. The wicks are reeled off bobbins, passing through the center of a series of moulds, each the exact size of a candle. The wax, which is *stearine*, *paraffin wax* or a mixture of both, is poured into the mould while molten. Circulating water in an annulus around the mould, cools and hardens the wax. The mould is now opened, and the candles lowered on the wick until enough for a fresh candle has entered the mould, the candles being thus made on a continuous wick.

Candle-power.—The standard candle, by which all lights are measured, is legally held to be a sperm candle consuming 120 grains of wax per hour. The lights are compared in a *photometer* while a test is being made.

Cane.—1. A name given to several peculiar palms, having very long smooth flexible stems, commonly called *rattan*.

2. Any plant with long, hard elastic stems; as, reed or bamboo of many kinds; also the *sugar-cane*.

3. A walking stick.

Cane Sugar.—The sugar existing in the sugar cane, date, beet-root, and the sap of the sugar maple. Also known as *sucrose*.

Cane Frame.—In textile manufactures, a cotton roving machine in which the rovings are fed into cans instead of being wound on bobbins.

Can Hooks.—Hooks reeved together by a chain or rope sling; used in lifting casks, etc., by their staves.

Cannel Coal.—A species of bituminous coal of fine texture and dull lustre. It is richest in hydrogen gas, and derives its name from the fact that a piece can be burnt like a candle.

Cannon.—A firearm of a size which requires to be mounted for firing. These implements of war date back from the beginning of the earliest history, and through centuries improvements have been made, until they have become what they are, as seen on our men-of-war and on the forts along the sea coast.

Cannon Clock.—A cannon with a burning-glass over the vent, so as to fire the priming when the sun reaches the meridian. Such pieces were placed in the Palais Royal and in the Luxembourg at Paris.

Cannon Metal.—An alloy of copper and tin, dark of color, also called *gun-metal*.

Cannon Stove.—A cast iron heating stove, somewhat cannon-shaped, the lower portion or bosh forming the fire pot and the upper a radiating surface. It has no flues proper, but the stove pipe stands upon the top, encircling the thimble. The door is higher than the usual level of the coals, and the middle zone of the stove may have doors and panes of mica.

Canoe.—A light boat, narrow in the beam and adapted to be paddled. They are able only to carry a light load, and are generally made of oak and cedar. It is the only mode of transportation by water known to uncivilized people. Canoes are made of all kinds of materials, from hollowed out trees, white birch bark, twig frame with hide coverings, etc.

Canopy.—In architecture, a covering or hood, the ornamental projecting head to a niche or tabernacle. The tablet or drip stone, whether straight or circular over the heads of doors and windows is so called if ornamented.

Can System.—In ice-making, where the water to be frozen is placed in oblong galvanized sheet iron cans, which are tapering in form, and three or four times as long and deep as they are wide, so as to expose the maximum surface to the cooling action of the brine in which the cans are immersed.

Cant.—An angle; a bevel; a chamfer; a slope; an arris; a hip; a ridge.

1. In building construction, a canted wall is one which forms an angle with the face of another wall; a canted column is one whose flutes are formed in cants instead of curves; when the angles are absent from a post, beam, or pillar, it is said to be *canted*. A canted moulding is one which has angular turns, but not quirks or circular work.

2. In shipbuilding, a *cant timber* or cant frame is one which is not square with the keel; the angle; as, of the head of a bolt. A bolt with hexagonal or octagonal head is said to be six or eight *cantred*.

3. In machinery, a segment of the rim of a wooden cog-wheel.

4. In cooperage, one of the segments forming a side piece in the head of a cask.

Cant Hook.—1. A lever and suspended hook adapted for turning timbers in the yard, on the skid or on the saw mill carriage.

2. A sling with hooks for raising and tilting casks, to empty them.

Cantilever.—1. In masonry, a shaped bracket of stone or slate, one end of which is pinned into a wall.

2. In engineering, a structure especially a bridge which is built out, bracket fashion, so as to resemble a cantilever.

Cantilever Bridge.—A bridge composed of two or more cantilevers which are built out from each side of piers to balance each other, thus enabling large spans to be covered with comparative ease, and ensuring rapidity of construction, the work proceeding at twice as many faces as there are piers.

Cantline.—The space between two casks or barrels stowed side by side.

Canton.—In building, a salient corner formed of a pilaster, or quoins which project beyond the general face of the wall.

Canvas.—A coarse cloth woven from flax, used for saifs, awnings, tarpaulins, etc.

Canvas Strap.—1. A piece of canvas used by electroplaters and polishers to put a finish on those parts inaccessible by the brush or bob; the workman takes an end of the strap in either hand, the work being held by an assistant or between his own knees.

2. An endless belt of canvas running over small pulleys and used for the same purposes as the above, the polisher manipulating the work on the moving strap.

Canvas Wheel.—Polishing wheels, buffs or mops made of canvas discs stitched together.

Caoutchouc.—(Pronounced *Ka-hoo-chooc*). The French spelling of the native South American name (*Cahuchu*) for the coagulated milky juice of various tropical trees and plants, which forms the gummy substance known as *India-rubber*. Artificial caoutchouc is prepared from a thick solution of glue, by the addition of sodium tungstate and hydrochloric acid. This forms a precipitate which, after cooling, can be rolled into sheets and pressed into moulds.

Caoutchoucine.—A volatile inflammable oil procured from the distillation of caoutchouc at a high temperature; it has been used as a refrigerant.

Cap.—1. In civil engineering, the horizontal beam connecting the heads of a row of piles of a timber bridge, trestle, or falsework.

2. In mining, a rock underneath which it is hoped to find ore in paying quantities.

3. In mining, the blue halo around a safety lamp in the presence of fire damp.

4. In millwrighting, the movable upper story of a windmill.

5. In machinery, the upper half of a journal box; the lower half is the *pillar*.

6. In mechanical engineering, the iron banded piece on the end of a wooden pump rod or pitman, by which it is connected with a working beam.

7. In architecture, a coping of a wall or parapet; a cornice above a door; the upper member of a molding; the upper member of a column or pilaster; also called, *capital*, *corona*.

8. In carpentry, the lintel over a door or window frame.

9. In paper making, the different sizes of paper, known under the names of *foolscap* and *legal cap*.

Capacity.—1. The power of receiving or containing; extent of room or space; used in reference to physical things.

2. The power of receiving and holding ideas, knowledge, etc.; the comprehensiveness of the mind; capability of understanding.

Cap Bolt.—A bolt securing the cap or keep of a bearing.

Cape.—In navigation, a piece or point of land, extending beyond the adjacent coast into the sea or lake; a promontory; a headland.

Cape Chisel.—A cross-cut chisel; one in which the cutting point is crosswise to the greater width of the tool. Used for cutting key-ways or for grooves of any description.

Cape Hood.—A form of vehicle top used on automobiles, which is capable either of being folded up, or extended to considerable length; so named from its original use on Cape carts—vehicles peculiar to South Africa.

Capillary Attraction.—In physics, a manifestation of the surface tension observed in all liquids. In fine tubes and bores, the surface tension is sufficient to balance a small column of liquid, maintaining it at a level above the outside. This is very noticeable in small glass tubes, sponges, or any porous substance such as loaf sugar. Where a liquid like mercury does not wet the tube, the behavior is different, as the level is maintained below that of the surface outside the tube; this is known as *capillary depression*.

Capital.—1. In architecture, the head or uppermost part of a column or pilaster. The capitals of the columns constitute the principal and most indicative mark of the respective orders of Grecian architecture.

2. In civil engineering, an imaginary line bisecting the prominent salient angle of a bastion or other work in fortifications, etc.

3. In printing, a large or upper case letter.

Cap Paper.—1. A kind of writing paper. Ruled with blue lines and folding on the back, it is *foolscap*; with red lines to form a margin on the left hand and made to fold on the top, it is *legal cap*.

2. A size of paper from $7\frac{1}{2} \times 12$ to $8\frac{1}{2} \times 14$ inches.

3. A coarse wrapping paper.

Capped Rails.—A railroad rail which has a steel cap attached to an iron body. It is generally made by so disposing the steel in a *fagot* as to form the edge of that metal in rolling. It is otherwise known as a *steel topped* or *steel headed rail*.

Capping Piles.—1. Placing a square timber on top of piles secured with spikes or tenons; squaring off the top of the two sides and notching away enough to give shouldering for a heavy plank on each side.

2. Filling around the top of the pile with *concrete*.

Cap Screw.—A screw-bolt intended to be used without a nut, so called because first used to secure the covers of small steam engines instead of studs. A cap screw is intended to be operated by a spanner, and therefore differs from a machine-screw, which is turned by a screw-driver. It differs from a set-screw in that its point does not come into contact with any part to hold it. The heads are square or hexagon and generally deeper than those of a bolt of similar diameter.

Capstan.—A winch or windlass with a vertical drum, worked by hand levers, or by steam or hydraulic power, used for warping a ship or hoisting anchor, etc.

Capstan Engine.—A capstan worked by steam power, the arrangement of parts resembling a winch, with worm gearing operating the vertical drums.

Capstan Lathe.—The same as *turret lathe*; one having a cylindrical rest from which project numerous tools, resembling the bars of a *capstan*.

Capstan Tool-rest.—In machinery, a thick perforated disc or circular tool-holder, attached to the upper part of a lathe rest and used for carrying drills and tools of various kinds. The drills are set radially in

the holes around the periphery of the disc and fixed by set screws put in from the top. Any number of duplicate pieces of work can thus be operated upon with different sized tools, with precisely similar results in each case, by slewing round the capstan and bringing the desired tools into alignment with the axis of the work centered in the lathe; also called a *turret rest*.

Capstone.—A flat stone used to surmount a wall, or to afford the upper surface of an engine foundation.

Car.—1. The cage of a lift or elevator.

2. The basket, box, or cage suspended from a balloon to hold passengers, ballast, etc.

3. A wheeled vehicle; a term generally applied to those that are used in railway service. The varieties are generally named according to their use; as, *box car*, *coal car*, *freight car*, *passenger car*, *refrigerator car*, *sleeping car*, etc.

4. A term applied to a large automobile.

Carascole.—In carpentry, a term sometimes used for a staircase constructed in a spiral form.

Carat.—1. A unit of weight for estimating the value of precious stones; it is equal to about $8\frac{1}{3}$ troy grains.

2. A term used to indicate the 24th part in expressing the purity of gold—pure gold being taken as 24 carats fine.

Caravan Boiler.—A wagon shaped boiler, used to a great extent on construction works, especially for making steam for pumps, etc., where a quick and frequent removal is required.

Car Axle.—The shaft which passes through the hubs of car wheels, and on which the latter are shrunk or pressed. The wheels of cars are fastened to their axles in order that they may successfully withstand the severe strains and jars to which they are exposed by the weight and surging of the cars and the inequalities of the track.

The axle constructed of one-piece metal, and with the wheels fixed firmly thereon, is subject to severe torsional strain in turning curves when the outer wheel has a circle of a larger arc to traverse, compelling the wheel on the inner and shorter circle to slip. The torsion of the axle is very detrimental, and the slipping of the wheel is equivalent to grinding on the rail, and retards the train.

Car Axle Lathe.—A lathe specially designed for turning car-wheel axles, being strongly geared for a heavy cut. The axle is hung upon the centres, on the head and tail stocks, and is rotated by the driver on the face plate.

Car Basket.—In railway engineering, a shelf or rack in a passenger car to contain small packages, shawls, satchels, etc.

Carbide.—A compound formed directly by the union of carbon with a metal. Cast iron is largely a carbide of iron; the carbides of calcium and aluminum are well known.

Carbide Feed.—A class of acetylene generators in which the calcium carbide is fed into the water.

Carbide of Iron.—In metals, a highly crystalline form of cast iron. It is extremely hard and brittle, and contains nearly all its carbon in the combined state. Hence called a carbide of iron.

Carbohydrate.—In chemistry, one of a group of compounds, including the sugars, starches and gums, which contain six, or some multiple of six, carbon atoms, united with a variable number of hydrogen and oxygen atoms, but with the two latter always in such proportion as to form water.

Carbolic Acid.—A powerful germicide and antiseptic obtained by distillation from coal-tar; it is the source of most of the disinfecting fluids sold, which possess the characteristic odor resembling creosote. It is a violent poison. Also called *phenol*.

Carbon.—In chemistry, an elementary substance, non-metallic in its nature, which is present in most organic compounds. It is combustible and forms the base of lampblack and charcoal and enters largely into mineral coals. In its crystallized state, it constitutes the diamond, the hardest of known substances, occurring in monometric crystals like the octahedron, etc. Another modification is *graphite* or blacklead, and in this, it is soft, and occurs in hexagonal prisms.

Carbonade or Black Diamond.—In minerals, a variety of carbon found in Brazil. It is as hard as the diamond, but free from its liability to split. It is used for turning down and truing emery-wheels.

Carbon Anhydride Process.—In refrigeration, a widely employed system wherein the anhydride of carbonic acid, better known as carbon dioxide, is used instead of ammonia. The cycle of working is the same, the expanded gas is drawn into the compressor, forced through a condenser, where it liquefies, is allowed to escape through a regulating or expansion valve into the larger volume of the expansion or evaporating pipes where it changes into gas, absorbing the necessary heat from whatever surrounds it, finally returning to the compressor to be used over again.

Carbonatation.—In sugar manufacture, the process of impregnating the limed solution of beet root, sugar or cane juice with carbon dioxide in order to induce precipitation of impurities.

Carbonate.—A salt formed by the union of carbonic acid with a base.

Carbonate of Copper.—A similar salt to the carbonate of zinc, prepared for electroplaters by precipitation, through adding a solution of copper sulphate (blue vitriol) to a heated solution of sodium carbonate.

Carbonate of Lime.—The chief constituent of incrustation in boilers, of the shells of sea-fish, birds' eggs, etc. Familiar as chalk and limestone.

Carbonate of Magnesia.—Carbonate held in solution in some feed-waters, and on deposition, producing incrustation. It is usually present in smaller quantity than is the case with the salt of lime.

Carbonate of Soda.—The principal production of the alkali industry, used in all arts and manufactures. Prepared by two methods, the *Leblanc* and *Solvay* processes. It is employed in making caustic soda, washing soda, soluble glass, and many other compounds.

Carbonate of Zinc.—Normally occurs in nature as *calamine*. The precipitated carbonate is a double carbonate and hydrate, and is prepared by mixing solutions of zinc sulphate and sodium carbonate, when it is thrown down as a white precipitate. Used for several purposes, notably by electroplaters in *brassing solutions*.

Carbon Bisulphide.—A colorless, mobile, very volatile liquid, prepared by passing the vapor of sulphur over red hot charcoal, and condensing the resultant vapor in a worm, the product being usually treated with mercury and corrosive sublimate and redistilled. It is used for many technical processes, as it is an excellent solvent of sulphur, phosphorus, fats, resin and india-rubber, hence is used for *belt-cements* and by rubber manufacturers. It is a violent poison, and very inflammable.

Carbon Dioxide.—A colorless compound gas heavier than air, neither combustible nor a supporter of combustion. It is evolved by the combustion of fuels containing carbon, one atom of that element combining with two of oxygen from the air, to form this gas; it is exhaled by respiration from the lungs; is poisonous if *inhaled*, as it prevents the blood from receiving its proper oxygen.

Carbonic Acid.—A weak and unstable acid formed by part of the carbon dioxide when dissolved in water. Hence carbon dioxide is termed *carbon anhydride*, as it is the *anhydride* of this acid, and also for the same reason *carbonic acid gas*.

Carbonic Acid Engine.—1. An engine driven by the expansive power of condensed carbonic acid gas.

2. A form of fire engine in which water is ejected by the pressure due to the evolution of carbonic acid in a closed chamber over water; or in which carbonic acid is ejected with the water, in order to assist in extinguishing fire by the exclusion of oxygen therefrom. The pumps are made to discharge water, into which a stream of carbonic acid is constantly driven by an air pump after the water has left the pump cylinders.

Carbonic Acid Gas.—Carbon dioxide was formerly regarded as the gas of carbonic acid and was known by this name. The term is still in familiar use in connection with refrigeration and soda water manufacture.

Carbonic Oxide.—In chemistry, a colorless gas, more correctly called *carbon monoxide*. It is a product of the incomplete combustion of carbon and is an abundant constituent of water gas. It is fatal to animal life, extinguishes combustion, and burns with a pale blue flame, forming *carbon dioxide*.

Carboniferous.—Coal bearing; the strata of the geologic period in which the coal measures were formed.

Carbonizing.—The destructive distillation of organic matters, as of coal in gas manufacture.

Carbon Monoxide.—A heavy gas composed of one molecule of carbon and one of oxygen. Known also as *carbonic oxide*. It is usually given off by the imperfect combustion of fuel when insufficient air is admitted; thus *producer gas* consists largely of carbon monoxide, which when burnt with a sufficient air supply forms carbon dioxide attended by the evolution of light and heat. Two per cent. of carbon monoxide in the atmosphere of a room will render a man insensible within half an hour, hence the danger associated with leaks from the water gas system of illumination.

Carbon Steel.—A term applied to such steels as contain carbon alone (together with slight impurities such as phosphorus, silicon, sulphur, etc.), as distinguished from the numerous *alloy steels*, which may also be mixed with chromium, manganese, molybdenum, nickel, tungsten, and the like, for special purposes.

Carborundum.—An abrasive material, resembling emery, but much harder than the latter. It is an artificial *silicide of carbon* formed in the intense heat of the electric furnace, the two elements not being combined in any manner in nature. Carborundum was first manufactured at Niagara, by Acheson.

Carboy.—A large jar or bottle of glass which is protected by a wicker basket or a wooden box, and used to contain acids.

Car Brake.—In railway engineering, an apparatus by which pressure is applied to the wheels of railway cars, to check their speed and eventually stop their revolution.

Car Buffer.—In railway engineering, a fender between cars. The ends of the car frames carry *buffer heads* with springs.

Car Bumper.—An elastic arrangement to lessen the jerk incident to the contact of colliding cars as the rate of speed is slackened; a term used to designate a *buffer* or *draw bar*.

Carburetted Hydrogen.—Two gases are known by this name. *Ethylene* or *heavy* carburetted hydrogen, which is present to the extent of three or four per cent. in ordinary coal gas, forming its chief illuminant constituent; *Methane*, marsh gas or *light* carburetted hydrogen which constitutes the miner's *fire damp*, the natural gas of Pennsylvania and Ohio, and forming about thirty-four per cent. of the volume of ordinary coal gas.

Carburetted Water Gas.—Water gas obtained by passing steam over red hot coke, to which vaporized oil gas has been added to increase its illuminating power.

Carburetter.—An appliance for mixing an inflammable vapor with air, especially in connection with internal-combustion engines. It acts by passing air through or over a liquid fuel and carrying off a portion of its vapor in combination, forming an explosive mixture.

Carburize.—To cause to unite with carbon or a hydrocarbon. Wrought iron is made to take up carbon from charcoal in the *cementation* process, and becomes steel. Illuminating gas has its quality improved by the addition of the vapor of volatile hydrocarbons.

Carcass.—1. In architecture, the naked shell of a house, side and roof without floors, joiners work, or plastering.

2. In shipbuilding, the keels, keelson, stem and stem posts, and ribs of a ship.

Car Coupling.—In railway engineering, a device for connecting the cars in a train.

Card.—1. In cotton and wool manufacture, an instrument for combing wool, flax, cotton, to disentangle or tear apart the *tussocks*, and lay the fibers parallel in order for spinning.

2. In silk weaving, one of the perforated pasteboards or sheet metal plates in the *Jacquard* attachment to looms for weaving figured fabrics.

3. In navigation, the dial or face of the mariner's compass, in which the needle and dial rotate together.

4. In the paper trade, a pasteboard. A thick paper sheet, made up of several layers.

Cardan Joint.—The *universal* or *Hooke's* joint, used in machinery to permit flexibility of motion in a shaft.

Cardboard.—Is produced by pasting a number of sheets of paper together. Bristol board is all white paper, and is made of two or more sheets according to the thickness required. Other qualities are made by enclosing common thick paper between sheets of white or colored paper of the required quality. A surface of paste is given between the contacting surfaces of the outside paper and the filling and a pack of pasted boards is subjected to a heavy pressure, which squeezes out the water. The cardboards are then hung up in pairs to dry, and in 24 hours are ready for the press which renders them smooth and polished. The cardboards are made up into a pack alternately with polished copper plates, and the pack is passed between a pair of rolls under heavy pressure. This removes all inequalities and wrinkles, the result being a highly polished glazed surface.

Card Cloth.—In textile manufactures, a stout fabric, frequently leather, into which is inserted hard steel wire staples, thus forming a brush for the purpose of carding fibres preparatory to drawing and spinning. In cotton manufactures, the gauge or spacing of the points varies according to the kind of cotton, American, Egyptian, Indian, etc. With *wool-carding*, the fineness or number per square inch, increases according to the nearness of the roller towards the delivery end of the carding machine.

Carding Engine.—In textile manufactures, a machine for cleaning and disentangling the fibers of cotton, flax, or wool and laying them parallel to each other for spinning. These operations are performed by large and small rotating cylinders curved with *card cloth*.

Careen.—1. In navigation, to cause a ship to lean or turn over on one side to facilitate repairing or cleaning.

2. The place where a vessel is *careened*.

Careful.—Full of care; anxious; solicitous.

2. Giving good heed; watchful; cautious; provident

Careless.—Free from care or anxiety, hence, cheerful; lighthearted. Having no care, not taking ordinary or proper care; negligent.

Caret.—A sign (\wedge) used in correction of manuscripts, etc. It denotes that the word or phrase, written above or below the line, is to be inserted between the two words where the caret is placed.

Car Fender.—A device in front of street cars, to prevent accidents. It is made of an iron pipe frame with wire netting in the form of a scoop, and is hooked on to the front platform. It covers a little more than the full width of the tracks.

Carga.—In shipping, a term applied to a lading or freight of a ship consisting of live stock, which distinguishes it from the word cargo, which means a loading of merchandise.

Cargo.—In transportation, the lading or freight of a ship or other vessel; the goods, merchandise, or whatever is conveyed in a vessel or boat; load; freight.

Cargo Ports.—Openings into the *tween-decks* or hold of a ship through her sides, which are closed when not in use, by caulked or jointed water-tight doors. Especially noticeable near the bows of timber ships, for passing long poles or beams in and out of the hold.

Car Heater.—A stove or hot water apparatus for heating the interior of railway-carriages.

Car Inspector.—In railway working, an official whose duties include examination of the rolling stock, its air brakes and appliances, to see that all is in proper order or to determine what defects are to be remedied.

Car Jack.—In railway engineering, a powerful form of jack by which a car or locomotive is lifted, to replace it on the tracks, to run a truck beneath, or for other purposes in the shop or on the road. They are also known as *screw*, *hydraulic* and *ball bearing jacks*.

Carmine.—1. A rich red or crimson color with a shade of purple.

2. In chemistry, an essential coloring principle of cochineal, extracted as a purple-red mass.

Carnauba Wax.—The wax deposited on the leaves of the wax palm, a native of Brazil. The crude wax is obtained by boiling the leaves; it is of a dirty yellow color, hard and brittle; is used for mixing with paraffin and other soft waxes in making candles, polishes, etc.

Carnegie, Andrew.—He was born at Dunfermline, Scotland, Nov. 25th, 1835; came to the United States in 1845. He attended school a brief period and while yet a boy, operated a small stationary engine, but soon became telegraph messenger for the Atlantic and Ohio Telegraph Co.; later he held various positions with the Pennsylvania R. R. Co., following which he became interested in a rolling mill, and subsequently acquired control of several iron and steel works. These were merged into the United States Steel Corporation. Mr. Carnegie has made many donations to towns and institutions; founded the Pittsburgh Institute, and has given large sums for libraries and other objects. He has written several books.

Carnot's Cycle.—The ideal or perfect engine cycle, or series of heat-changes, devised by the French Scientist Carnot (1824).

Carnot's Principle.—In physics, this principle is, that the amount of work done by a heat engine is independent of the nature of the intermediary agent employed, being dependent upon its temperature alone.

Carpenter's Clamp.—A frame in which work, such as doors, sashes, shutters, etc., is forced up into place, and held while being nailed or pinned. A kind of vise for grasping several parts and holding them, while the glue sets, or for other purposes.

Carpenter's Gauge.—A scribing tool for depth or width, according to the construction and uses. It commonly has a point projecting from the shank and a movable head or fence, which is adjusted for distance from the point, and secured by a set screw.

Carpenter's Level.—A device for determining a horizontal or vertical surface.

Carpenter's Plane.—Carpenter's planes are of various descriptions adapted to the kinds of work they are intended to perform; as, a *jack plane*, for rough dressing a surface, a *smoothing plane*, for finishing off, and *grooving* and *moulding planes*.

Carpenter's Plow.—A plane for making a groove in the edge of the board, to be occupied by the matching *tongue* of another board, or by the edge of a panel.

Carpenter's Rule.—Ordinarily, a two foot rule, jointed in the middle and divided into eighths or sixteenths of an inch. Some have a pointed swinging arm, and also a curved scale and pointed index, so that the instrument may serve the purposes of a level, square, and bevel, any angle of inclination being noted by the pointer upon the scale.

Carpenter's Square.—An L shaped steel rule having a blade and a tongue meeting at right angles and graduated into feet, inches and fractions. Generally the blade is 24 inches long, the tongue 18 inches long. It is used by carpenters and other mechanics for laying off perpendiculars to a line or surface and setting off the distances thereon at the same time.

Carpentry.—The art or handicraft of constructing the framing or structural parts of a building or of a wooden ship; it deals with beams, joists, partitions, bulk heads, decks, etc., and is distinguished by a considerable employment of mortising, tenoning, and similar fitted joints. Smaller and more finished parts such as doors, windows, stairways, wainscoting, etc., are termed *joinery*, but the work of the carpenter although heavy and substantial must in no case be considered *rough work*, as care, accuracy and scientific principles are fully demanded in it.

Carpet.—A woven or felted floor covering. The woven carpets constitute two great classes; (a) plain woven fabrics such as *Kidderminster*, and (b) the various kinds of piled carpets. One class of the latter, with uncut loops, is termed *Brussels*; the loops being cut to form a nap gives *Wilton* carpets; tufts of colored wool are knotted into the weaving as it proceeds, thus forming *Persian*, *Turkey* or *Azminster* carpets.

Car Puller.—A device consisting of a belt or motor-driven windlass or capstan, used for shifting cars under grain elevators, in place of the employment of a switching engine.

Car Replacer.—In railway engineering, an implement or means for restoring to the rails, a car which has run off the track.

Carriage.—1. In engineering, the saddle of a lathe, that portion of a slide rest which moves upon the lathe bed, gripping its edges by *V's* or other methods.

2. In certain types of printing machines, a horizontal table traveling to and fro under the cylinder or roller. With small presses, the carriage bears the form of type upon its surface, the paper being carried by the cylinder; with large presses the type is carried on the cylinder, and the carriage supplies the paper.

3. The part of a typewriter which holds the paper, and causes it to traverse laterally in front of the type bars.

Carriage Jack.—A lifting jack employed by coach builders, stablemen and others, to lift the wheel of a carriage from the ground, by jacking up its axle, thus permitting revolution of the wheel for washing, painting, etc.

Carriage or Locomotive Hoist.—In machine shop practice, this consists of a set of shear legs, erected in repairing sheds for the purpose of lifting the trucks or engines off their axles when repairs are necessary. The ends of the shear legs are often sunk in cast iron shoes buried in the ground.

Carriage Spring.—An elastic device interposed between the bed of a carriage and its running gears, to lessen the jar incident to inequalities in the road.

Carrick Bend.—A knot employed by seamen and erectors to bend a smaller line on to one of larger diameter; it consists of a loop of the small line passed alternately under and over a bight of the large rope.

Carrier.—1. A person or corporation engaged in transportation.

2. A receptacle used in connection with a conveyor system, such as a bucket on an aerial electrical railway, or a ball on a cash railway.

3. A dog or holder screwed upon the end of a round bar in a lathe, so that it may be rotated between the centers.

4. In textile machinery, the first roller in a carding-engine, which unwinds the lap and distributes it to the machine.

5. An intermediate roller on a scribbling machine, or coarse wool-carder, between the feed rolls and the toothed drum.

Carry.—To convey or transport in any manner from one place to another; to bear; to have or hold as a burden, while moving from place to place.

Car Shop.—A place of manufacture or repair of cars, especially railway vehicles.

Car Starter.—In railway engineering, a device to assist in starting a street car from the dead stop. There are two kinds; (a) those in which the momentum of the car when the motion is arrested is made to accumulate a starting force; (b) a device in

which the power of the team is temporarily applied to give a direct impulse upon the wheel, so as to start the latter rolling, and then transfer the power of the car.

Cart.—A two-wheeled vehicle for the ordinary use of hand delivering, and also for transporting bulky and heavy articles. They are pulled by horses, or pulled and pushed by men, and vary in size and shape. The most frequent names are *dump cart*, *horse-cart*, *push-cart*, *hand-cart*, etc.

Cartload.—As much as will fill or load a cart. In excavating and carting of sand, gravel, earth, etc., one third of a cubic yard of the material before it is loosened, is estimated to be a *cartload*.

Cartman.—One who drives or uses a cart, a *teamster*; a *carter*.

Cartouch.—1. In architecture, a cantilever, console, corbel, or modillion, which has the form of a *scroll* of paper.

2. A tablet for ornament, or for receiving an inscription, formed like a sheet of paper with the edges rolled up, hence any *tablet* of ornamental form.

Cartridge.—A case or shell usually made of metal, pasteboard, flannel or serge, which contains the charge of powder for fire-arms. For dynamite, etc., the cartridge is enclosed in a cylinder of oiled paper, the size to fit the drilled hole.

Cartridge Paper.—A coarse kind of paper, formerly used in the manufacture of cartridges, now much used for drawings. Its merits are cheapness and the fact that it can be procured in continuous rolls of considerable width, thus rendering it available for the large drawings frequently necessary in engineering and shipbuilding.

Car Truck.—In railway engineering, a wheeled carriage beneath a railway car. The first railway cars had wheels on axles, arranged similarly to those of a wagon. It was afterwards found more convenient and efficient to shrink the wheel on the axle, so that they might revolve together.

Cartwright, Edmund.—He was born at Marnham, Notts, Eng. 1743; died 1823. He was the inventor of the power-loom for weaving although he was educated for the Church. While engaged in literary work his attention was accidentally drawn to the subject of mechanical weaving. In April 1785, his first power-loom was put in motion: and although its

introduction was much opposed both by manufacturers and workmen, it gradually rose into importance until it became one of the greatest of the mechanical forces of Great Britain. In 1808, Parliament granted him £10,000 for the good service he had rendered the public by his invention of weaving.

Carving.—The art of cutting wood, etc., to ornamental forms by means of chisels, scrapers, gravers, etc. With metal it becomes *chasing*, with plastic material, *molding*. The ornamentation of the day consists of copies of natural objects.

Carving Chisel.—A chisel having an oblique edge and a basil on both sides.

Car Wheel.—One adapted for the use of cars, or the truck of railway cars. They have a flange to guide them in running on the edge-rail, and are made from cast-steel.

Car Wheel Lathe.—One which is adapted for turning off the rims of two driving-wheels after they have been pressed on the axle, or for turning off the wheels separately.

Case.—In founding, the external portion of the mould, in loam moulding. In sand moulding, the same as *cope*.

Case-bay.—In carpentry, the space between a pair of girders or two principals of a roof or ceiling.

Case Hammer.—A light hammer with two flat faces, used by jewelers, sheet-metal workers, etc.

Case Hardening.—In *engineering*, a process whereby a hard steel skin is formed on mild steel or wrought iron articles, the process consisting of *heating* them to a cherry red in a closed vessel along with bones, hides, horn, or other carbonaceous materials, and then suddenly quenching in cold water.

Casein.—The essential, characteristic *albumin* of milk; therefore present in butter and in cheese. It is composed of carbon, hydrogen, nitrogen, oxygen, sulphur and phosphorus; is an acid, insoluble in water. Casein is used as a binding material for washable water paints.

Case Lock.—In carpentry, a *bow lock* screwed on to the face of a door.

Casement.—In building, a sash or glass frame, opening on hinges and revolving upon one of the vertical edges.

Cash.—Ready money, especially coin or specie; but also applied to banknotes,

drafts, bonds, or any other paper easily convertible into money.

Cashier.—One who has charge of money; a cash-keeper; one who has charge of the payments and receipts of a bank or factory.

Cash Railway.—A light, aerial railway, erected in stores to carry money or light parcels to and from different parts of the establishment.

Cash Register.—A machine which, when numbered keys are pressed, keeps an account of cash taken in from sales of goods, etc.

Casing.—Any external covering or protection, as:

1. The steam or valve chest of an engine; the external shrouding or housing of a steamship's funnel, where it passes through the *hull*; woodwork built around the interior of a cabin; covering or conduits for steam and other pipes, electric leads, etc.; a guard over gear-wheels, etc., to prevent accidents.

2. Tubes or piping, screwed together in lengths, employed to line artesian wells, preventing the entrance of surface water and also caving-in of the strata.

Casing Dogs.—In *boring*, a fishing instrument, provided with serrated pieces or dogs sliding on a wedge, to grip severed casing.

Casing Elevator.—A *well-boring* device consisting of two semi-circular clamps, with a chain-link on either, which are hinged together at one end, and secured by a latch at the other. This affords a quickly applied and released attachment for casing to the lifting tackle.

Casing Head.—In *well-boring*, a heavy mass of iron screwed into the top of a string of casing to take the blows produced by driving the pipe home.

Casing Shoe.—In *well-boring*, a ring or ferrule of hard steel with a sharp edge, screwed on to the bottom of a string of casing, to cut its way through the formation, as the pipe is forced down.

Cask.—A barrel; a vessel of bulging middle form, with flattened ends, usually of water-tight construction. A cask is built of *staves* whose curvature varies for different contents, these staves being glued together if used to contain liquids, and always secured by *hoops* around them; the three pieces comprised in either *head* being fastened together by *dowels*, and retained in place by a groove or channel termed the *croze*, on the inside of the staves.

Cassiterite.—The most important ore of tin, often called *tin stone*. It is found in Cornwall, Devon, Saxony, Perak, Banca, United States, Australia. *Stream-tin* is waterworn cassiterite, and is found as pebbles, gravel or sand, like other water-borne materials.

Cast.—1. A facsimile of a piece of sculpture or other object. The object to be reproduced is smeared with a *parting* of boiled soft soap or the like; it is then covered in sections, with molten wax or wet plaster of paris, so as to form a mould. The sections are taken apart, covered with a parting, and then fitted together once more, plaster and water being poured in to fill the mould. When the cast is set, the sectional mould is once more removed, leaving a facsimile reproduction of the original object. To avoid mistakes, the plaster composing the mould is tinted yellow or some other distinguishing color, so that if it should be necessary to cut it away, the cast is not injured. A *bronze replica* of a wax model is made in the same manner.

2. In foundry work, to form into shape by pouring melted metal into a mould.

Castellated Nut.—A nut with notches cut in its upper edge, like the battlements of a *castle in chess*. This device permits adjustment of the nut to various positions relative to the split-pin or cotter, thus permitting easy adjustment for taking up wear.

Caster.—A small wheel attached to the leg of a table, a chair, or other piece of furniture, to facilitate its being rolled about without lifting.

Caster Bit.—A bit for a carpenter's drill stock, which is fluted like a twist drill, so that in boring holes through old wood, it will cut through a nail without injury to the bit.

Cast Holes.—In foundry work, holes are cast to lessen the labor of drilling, being cast small and broached and reamed out afterwards. Large lightening and clearing holes are always cast. Core prints usually indicate the positions of cast holes on patterns. Cast holes are necessarily rough and their accuracy no quite reliable.

Castings.—A metallic object formed by running molten metal into a mould of sand or plaster, which has been previously prepared from a model or pattern of the requisite form.

Castings Box.—In foundry work, a *flask* or box designed to contain the mould.

Castings On.—In foundry work, a method of uniting cast and wrought iron in

which the cast-iron part of a structure is poured on to the wrought-iron portion in the mould; as, the hub of a wrought-iron pulley.

Casting Pit.—A large and deep pit sunk in a foundry floor and lined with cast-iron plates or bricks. Used for the reception of moulds which have to be placed on end for the purpose of sound casting.

Cast Iron.—A carbide of iron, containing from 3 to 5 per cent. of carbon, both combined and as graphite, and about 2½ per cent. of silicon. This variety of iron, the production of the blast furnace, is valuable on account of the ease with which it can be melted and cast into moulds. It possesses great compressive strength, 90,000 lbs. per square inch, but is weak in tension, breaking at about 18,000 lbs., and is therefore used for building members in compression, and those parts of an engine such as cylinder and bed plate which are more easily cast to form than manufactured in other ways.

Castor Oil.—A vegetable oil, expressed from the seeds of a plant cultivated in India, Java and the East generally. The first quality is produced by pressure alone, and is hence termed *cold drawn*, this is employed in medicine; second and third qualities are obtained by grinding and heating the crushed seeds and re-pressing the meal. These qualities are used as *lubricants* and for dressing chamois and morocco leather. The specific gravity of castor oil is about .960 to .966 at 60° F.; it is one of the best lubricants known for the running parts of heavy machinery.

Cast Steel.—Steel, usually open-hearth, which is cast into sand moulds like cast iron. The moulds require to be carefully made, and patterns should have more *draw* than for iron; furthermore, the castings should be removed from the sand as soon as possible and carefully annealed to prevent cracking or damage from internal stresses; the resultant casting is much stronger than cast iron. The same as *crucible steel*.

Cat.—1. A tackle, used with stocked anchors, to heave them from the hawse hole to the *cat-head*, where they are slung for tripping, or *fished* for the voyage.

2. An abbreviation for catalogue.

Catalysis.—In chemistry, a process by which reaction occurs in the presence of certain agents which were formerly believed to exert an influence by mere contact. It is now believed that such reactions are attended with the formation of an intermediate compound or compounds, so that by alternate composition and decomposition the agent is apparently left unchanged, as, the catalysis of making ether from alcohol by means of sulphuric acid. Also called *catalytic action*.

Catalytic Ignition.—Ignition of internal combustion engines, effected by the employment of spongy platinum, which is capable of absorbing many times its bulk of hydrocarbon gases, becoming heated in the process.

Catamaran.—A craft consisting generally of two narrow boats or logs with a platform between them, or else of one long narrow hull, with a parallel log, acting as outrigger. The sail is sometimes lateen or a sprit-sail; astonishing speeds are credited to these craft.

Catapult.—1. In engineering, the first example in the early history of the engine, and used by the ancient Greeks for defence. It was a machine somewhat resembling a massive cross-bow and used for throwing stones, arrows, spears, etc.
2. A forked stick with an elastic band for throwing small stones.

Cataract.—In machinery, a kind of hydraulic brake for regulating the action of pumping engines and other machines, sometimes called a *dashpot*.

Cat Block.—In navigation, a two or three fold block, iron bound with a large iron hook attached to it, employed to draw the anchor up to the cathead. On the forward part of the shell of this block are two small eye bolts for the purpose of fitting a small rope, called the *backrope-bridle*, used in hooking the cat.

Cat Boat.—A small sailing vessel with one mast stepped well forward, carrying a mainsail only; also known as *Una rig*.

Catch.—To hold on; to seize; especially with one's hands; to grasp while in motion; to get possession of; to attain; to come upon unexpectedly, or by surprise.

Catchment Area.—In hydraulics, the extent of country drained by the springs and water courses which supply a waterworks.

Catch Plate.—In turning, a small driving chuck placed on the lathe mandrel to rotate the work. It is fitted with a projecting pin or *snug* to engage the dog or carrier on the piece in the centers.

Catch Points.—Self-acting railway derailing switches placed at various positions on inclines to protect following trains in case of a *break-away*. They are also occasionally placed outside busy junctions to prevent freight cars being accidentally shunted so as to foul the running lines.

Catchwater.—1. In steam engineering, a separator or steam drier.

2. In civil engineering, a ditch or drain to intercept waters from high lands, to prevent their accumulation upon lower levels.

Catch-water Drain.—On a steam engine, the pipe which carries off the water from the catch-water or interceptor.

Catch Work.—In irrigation, a work of artificial water courses for throwing water on lands that lie on the slopes of hills; a *catch-drain*.

Catechise.—To instruct by asking questions, receiving answers, and offering explanations and corrections; to question or interrogate, to examine or try by questions.

Catechism.—1. A form of instruction by means of questions and answers.

2. A book containing a summary of principles, reduced to the form of questions and answers.

Catechu.—Also known as *cutch*. A hard dark brown, brittle substance derived from the wood of East Indian trees of the acacia variety. It is a valuable astringent in medicine, and is much used as *dye stuff*.

Catenary.—The curve naturally assumed by a rope, chain or other flexible body of uniform section, when suspended without strain between two points.

Catgut.—1. A cord of great toughness made from the intestines of animals, especially of sheep.

2. A sort of linen or canvas, with wide interstices.

Cathead.—1 A beam projecting from the bows of a ship, to which stocked anchors are made fast.

2. In mining, a capstan of small size.

Cathetometer.—In engineering, a microscope or telescope mounted horizontally upon a vertical support, so arranged that it may be raised or lowered, but the tube always remains horizontal. The height through which it has been moved is read from a finely divided scale, and the instrument is thus available for measuring small differences in height, especially at some distance.

Cause.—That which produces or effects a result; that from which anything proceeds, and without which it would not exist; that which is the occasion of an action or state.

Caustic.—A term applied to any base or alkali which eats away or destroys animal tissues by burning or corroding; biting.

Caustic Potash.—A caustic alkali prepared from wood ashes or pearl ash, slaked lime, water, etc. Caustic potash is used to prepare soft soaps by boiling with vegetable oils, as a cleanser, as a caustic in medicine, and in very many other ways. It is a hard white, brittle substance, easily soluble in water.

Caustic Soda.—In chemistry, a hydrate of soda; a solution of potash and soda. Useful for removing incrustation from steam boilers.

Caution.—A careful attention to the probable effects of an act, in order that failure or harm may be avoided; prudence in regard to danger; provident care; wariness.

Cave.—1. A hollow place within the earth; hence, to form a hollow as by falling in of the sides of a well. As a verb, the word has become specialized, signifying collapsing of the strata through which a drift or bore hole is being driven.
2. The ashpit underneath a glass furnace.

Cave-in.—Falling in of the sides of any excavation or hole.

Caving System.—A method of mining, by which the worked out upper levels and surfaces are allowed to subside gradually as the mine workings are deepened. Somewhat like the *long wall* method of mining coal.

Cavity.—A hollow place; a hollow; as, the spoon is an instrument with a small cavity.

Cavo Rilievo.—In architecture, a species of carving in which the projecting parts of the sculpture are on the same level as the general surface.

C. E.—An abbreviation for Civil Engineer.

Cease.—To come to an end; to stop; to leave off or give up; to desist; to be wanting; to pass away.

Cedar.—The name of several evergreen trees. The wood is remarkable for its

durability and fragrant odor, and on that account is largely used for clotheboxes or boxes.

Cedilla.—A mark placed under the letter C (thus Ç) to show that it is to be sounded like S, as in façade.

Ceil.—In carpentry, to overlay or cover the inner side of a roof; to furnish with a ceiling; as to *ceil* a room.

Ceiling.—The overhead covering of a room or apartment, which hides the joists or rafters above; internal sheathing, especially of a roof or covering surface, as the sheathing of a car roof.

Ceiling Joist.—In carpentry, one of the joists spiked to a *binder* and serving as a point of attachment for the plastering laths of the ceiling.

Cell.—1. A small compartment or space enclosed by walls.

2. A single element of an electric battery, either primary or secondary, usually the former. It generally consists of a jar filled with a liquid or a paste electrolyte, in which the electrodes are inserted or with which they are connected.

Cellar.—1. A room under a house or other building.

2. The lower part of an axle or journal box, containing the lubricant and the pad or waste which applies it to the journal.

Cell Plant.—In ice-making, a method of arranging the ice-tank or freezing-bath whereby it is divided into a number of cubical cells, in the hollow walls of which the cold brine circulates, the water being mechanically agitated as it freezes. When the process of freezing is complete, hot brine is circulated through the walls to thaw out and loosen the blocks of ice, which are then lifted out by a crane.

Cellular.—Consisting of, or containing cells; of or pertaining to a cell or cells.

Cellular Tire.—A cushion tire for vehicles, in which the tube is subdivided into cells or compartments to secure elasticity and lightness.

Celluloid.—A hard flexible substance formed from a mixture of camphor and pyroxylin, which is the same as gun-cotton. The camphor is dissolved in alcohol, the gun-cotton added, and the mass incorporated between rollers; it is then warm-pressed into the desired form. The coloring is usually added during the incorporation. Celluloid is largely used as a substitute for ivory, bone and horn in various useful and ornamental articles. It is highly inflammable, but non-explosive,

Cellulose.—An organized structure of unknown chemical constitution, whose composition is allied to that of *starch*. It is insoluble in hot or cold water and all ordinary solvents.

Celsius Thermometer.—The *Centigrade* thermometer, so called from its inventor André Celsius, a Swedish astronomer.

Cement.—Any substance which causes bodies to adhere to one another, such as mortar, plaster of paris, glue, etc. Used without qualification, the term denotes *Portland cement*, also stucco, natural and Roman cements, etc.

Cementation.—The oldest method of steel manufacture. Bars of wrought iron, of best quality, are buried in powdered charcoal within fireclay boxes, the whole being sealed or *cemented* with fireclay. These cementation boxes are placed within a furnace and brought to a bright red heat, the length of the heat depending upon the amount of carbon desired in the product; the process may continue for a fortnight with highly carbonized steels. From their being covered with blisters, the steel bars produced are known as *blister steel*; they are broken up, piled, heated in a reverberatory furnace, and subjected to rapid blows, which gives them a fibrous quality, forming *shear steel*; a repetition of the piling process produces *double shear steel*, also called *crucible steel*.

Cement Copper.—In mining, copper extracted from the water which is pumped out of copper mines. The water is pumped into tanks containing scrap iron, forming sulphate of iron, and copper deposit. It is therefore almost in a state of chemical purity.

Cement Mill.—A mill for grinding the stony concretions from which cement is derived. The main operations are the *crushing* of the stone, then the *pulverizing* and after this, the *screening*.

Cement Tester.—A form of machine used especially for the testing of the tensile and crushing strengths of cements, the specimen being especially moulded for the purpose.

Censor.—One who is empowered to examine manuscripts before they are committed to the press, and to forbid their publication if they contain anything obnoxious.

Censure.—To find fault with and condemn as wrong; to blame; adverse criticism; reproach.

Census.—An official registration of the number of the people, the value of their estates, and other general statistics of a country.

Cent.—1. A small U. S. coin, the hundredth part of one dollar, made of copper, tin and zinc.

2. An abbreviation for *centum* or *cento* meaning hundred, used chiefly in the phrase *per cent*.

Cent.—An abbreviation for *central* and *century*.

Cental.—A weight of one hundred pounds, used in the weighing of certain cereals in the Liverpool grain market since 1859.

Center. 1. In machine work, one of the points on the lathe spindles on which the work is placed. The front or *live center* is on the spindle of the *head stock*. The centers of a planer are on stocks temporarily attached to the bed of the planer, so that the object may be turned on its axis in the course of the work thereon.

2. A point equally distant from the extremities of a line, figure, or body, or from all points of circumference of a circle; the middle or central portion of anything.

3. In architecture, a temporary structure upon which the materials of a vault or arch are supported in position until the work becomes self-supporting.

Center Bearing.—In a *locomotive*, the annular bearing surface around the central pin of a truck; it sustains the weight of that portion of the engine.

Center Bit.—In carpentry, an instrument turning on a center, for boring circular holes.

Center-board.—A shifting or drop-keel, fitted to small craft; it is capable of being raised or lowered through a vertical casing or well, and is used in tacking to prevent leeway or side drifting.

Center Gauge.—In shop practice, steel gauges, usually to 60°, for imparting the correct angle to lathe centers.

Centering.—In civil engineering, etc., the elaborate scaffolding and false work of timber erected to serve as a gauge and a support during the construction of an arch.

Centering Machine.—A special machine tool for facing the ends of forgings, straightening them and making proper centers therein for subsequent turning.

Centering Rest.—An L-shaped rest used in conjunction with a square center to form centers in a piece of work. The *centering rest* is held in the *slide rest* and is used to force the bar into position, while the square center cuts or *reams* its way into the end of the piece.

Center Key.—In engineering, a drift or tapered cotter fitting within the transverse slot or cotter hole of a drill-socket or sleeve, so that by a wedging action on the end, a drill may be forced out.

Center Line.—1. A dotted or broken line shown in a drawing of machinery, denoting the center of an object; the lines of a force, or the limits of motion of the center of a vibrating part. On finished drawings, center lines are sometimes shown in red ink, to distinguish them from dimension lines which are usually blue.

2. A line marked centrally upon a piece of work on the marking off table from which dimensions are set forth.

Center of Gravity.—In physics, that point of a body about which all its parts are balanced, or which being supported, the whole body will remain at rest, though acted upon by gravity.

Center of Gyration.—In mechanics, that point in a body rotating around an axis, at which, if a given force were applied, it would produce the same angular velocity in a given time as it would if the whole mass of the body were collected at that point.

Center of Oscillation.—In physics, the point in which, if the whole matter of a suspended body were collected, the time of oscillation would be the same as it is in the actual form and state of the body.

Center of Percussion.—That point, in a body revolving about an axis, at which it might be struck without causing any pressure on the axis; or that point at which if a blow be struck by the body the action is the same as if the whole mass of the body were concentrated at that point.

Center Pin.—In locomotives, a substantial pin of steel or wrought iron fixed into the engine frames and serving as a pivot on which the truck or bogie may move in a circular direction.

Center Plates.—In pattern making, plates of brass or iron upon which wood-patterns are turned in the lathe. They also afford a means of temporarily joining the two halves of a pattern together, either by screws or by projecting teeth from the plate.

Center Punch.—A pointed tool used to mark out center lines or centers for drilling work, etc. Light punches for

distinguishing the scribed lines on a job to be machined are known as *dotting* or *prick punches*.

Center Reamer.—In machine practice, a fluted conical reamer, not unlike a countersink, used to enlarge a previously drilled hole in the end of a shaft preparatory to turning, thus giving it the correct angle and size to fit the lathe center.

Centers.—A lathe is said to be of such and such centers, meaning the height of its centers above the bed; a lathe is described as being of a certain swing, which is double that of its centers; thus a ten inch center lathe, would be listed by a toolmaker, as twenty inch swing.

Center Sill.—In locomotive work, the central longitudinal members of the framing of a tender, designed to transmit the drawbar pull and also withstand shocks.

Center Square.—A T-square, in which the head is shaped like the letter V, the edge of the blade being perpendicular to the vertex of the angle. Hence, when it is applied to the end of a shaft the edge is always a diameter of the circle; two such diameters being scribed, their point of intersection is the center.

Center Weight Governor.—A high speed centrifugal governor, whose balls have to overcome the weight of a mass sliding on the central spindle. This makes a sensitive governing apparatus, on account of the higher speed which can be maintained, and a small weight governor is as effective as a large one of the ordinary type. Also known as the *Porter governor*.

Centigrade Thermometer.—The *Celsius thermometer*, used in France and Germany, and in scientific work everywhere. In its scale 0° is the temperature of melting ice, 100° that of boiling water under the pressure of one atmosphere; hence the name *centigrade*. Centigrade temperatures are converted into those of Fahrenheit's scale by multiplying the former by nine, dividing the product by five, and adding 32 to the quotient.

Central Load.—In engineering, a weight concentrated at the center of a beam or other structure.

Central Position of Slide Valve.—In engineering, when the valve is placed so that it covers both steam ports, and equally overlaps each side.

Centrifugal Drill.—A drill press in which a fly wheel is fitted to the stock to secure uniformity of motion.

Centrifugal Force.—In physics, the force which acts upon a body revolving in a circular path, tending to force it farther from the center of that circle. If the centrifugal force is just sufficient to balance the attraction of the mass around which it revolves, the moving body will continue in a uniform curved path. Should the centrifugal force increase, the body will either take up a larger path at a further distance from the center, or else tend to fly off in a straight line.

Centrifugal Governor.—A steam engine governor, in which the centrifugal force acts upon two or more revolving balls or weights. It is attached either to a throttle valve or the valve gearing and governs (a) by shutting off the steam supply as the velocity of the balls increases, also increasing the supply of steam as the velocity decreases, or (b) by changing the cut-off.

Centrifugal Machine.—A machine for the utilization of centrifugal force; usually one in which a liquid is expelled radially from a substance placed within a rapidly revolving pan, or wherein a light liquid is separated from a heavier one by the same means.

Centrifugal Pump.—In hydraulics, a pump in which the moving part is a revolving wheel or fan with curved vanes or spokes. The liquid is admitted at the center of the fan, and being carried round by centrifugal force, escapes from the tip of the blades.

Centrifugal Reel.—A flour dressing machine consisting of a skeleton cylinder, covered with fine silk gauze, fixed horizontally, and revolving slowly within a chest. The material to be sifted is fed into one end of the cylinder or reel, thus dressing the flour or sifting it. The flour is carried away by conveyors, while the unsifted material or *tail* passes out at the end of the cylinder for further treatment. By the provision of different meshes of silk on the reel, together with suitably disposed *cut offs* and hinged doors over different conveyors, it is possible to grade different varieties of flour in one machine.

Centrifugal Separator.—A centrifugal machine usually for separating cream from milk; a *hydro-extractor*.

Centripetal Force.—That force which draws or impels a body toward some point as a center.

Century.—A period of hundred years; as, this event took place over two centuries ago.

Ceramic.—Of, or pertaining to, *pottery*; to the manufacture of china, porcelain, terra-cotta, etc.

Ceremony.—An act or series of acts often of a symbolical character prescribed by law, custom or authority, in the conduct of important matters, as in the transaction of affairs of state, and the celebration of notable events; as the ceremony of taking oath of office.

Cerium.—A rare metal, having a specific gravity of 5.5, of an appearance between iron and lead. It is found in the rare mineral *cerite*. The crude sulphate of cerium obtained from *cerite* is utilized in dyeing; the *dioxide* forms one per cent. of the mantle used in incandescent gas lamps.

Cerro.—A word from the Spanish, signifying a hill with rock outcrops.

Certain.—Assured in mind; having no doubts; free from suspicions; not to be doubted.

Certainty.—The quality, state or condition of being certain; a fact or truth unquestionably established.

Certificate.—A written and formal testimony to a fact. With engineers, it is a diploma showing that they have successfully passed an examination and are therefore legally qualified to hold a certain position. A *license*, on the contrary, is an official permit to hold a definite position, and is issued subsequent to satisfaction of the supervising authorities.

Certified Check.—A bank check, the validity of which is certified by the bank on which it is drawn.

Cerussite.—Carbonate of lead; a valuable ore of lead when it exists in quantities; it is found either in crystals or massive; the lustre of the crystals is very brilliant.

Cesspool.—A cavity formed to receive sewage where drains are not provided to remove it from the district by water carriage. The following conditions should be observed:—The cess-pool must be absolutely watertight, placed safely away from wells or streams, and should be regularly emptied and cleansed.

C. G. S. system of measurement.—An abbreviation of *centimetre-gramme-second*, the standard system adopted in chemical and electrical work. The *centimetre* is taken as the unit of distance or space, the *gramme* is the unit of mass, and the *second* is the unit of time, the unit of velocity being 1 *centimetre in one second*.

Chafe.—To rub, to come together so as to wear by rubbing; injury or wear caused by friction.

Chaff.—Particles of the stalks of grain which require to be separated from the berry in the preliminary processes of milling; also broken pieces of straw ejected from the beaters of a threshing machine.

Chaff Cutter.—An implement for chopping fodder into short lengths of about half an inch, to render its mastication easier by the animals, and facilitate mixing. The hay or straw is fed through a spout by means of toothed rolls, and, in its compressed state, is cut up by revolving knives fixed upon a fly wheel.

Chafing Gear.—In navigation, parceling or *serving*, on ropes to keep them from being chafed by running rigging.

Chain.—1. A series of links or rings, usually of metal, connected or fitted into one another; used for various purposes, as for support, connection, or the exertion and transmission of mechanical power.

2. A measuring instrument used by surveyors. It consists generally of 100 links, the length of the link varying with different standards. Called *surveyors' chain*.

Chain Belt.—A belt composed of chain-links, used for transmitting power.

Chain Block.—A pulley block, in which the rope fall is replaced by a chain; the ordinary *Weston* block is generally understood.

Chain Brake.—In railway working, an early form of a continuous brake, in which the power was applied by winding on a chain that extended the whole length of the train and actuated the gear on each coach.

Chain Bridge.—A bridge suspended on chains; a *suspension bridge*.

Chain Cable.—In navigation, an anchor-cable made of chain.

Chain Drive.—In an automobile, when the driving axle is driven by the interposition of a chain, instead of a shaft and bevel gearing.

Chain Lewis.—A device for slinging stones, large masses of concrete, etc.; two curved pieces of steel are introduced into a lewis or dovetailed hole in the block, like *l*. The strain on the chain through their upper extremities forces their points outwards and grips the stone to be lifted.

Chain Locker.—A strong compartment in the fore-hold of a vessel for holding the chain-cables.

Chain Man.—A surveyor's assistant, who manipulates and carries the measuring chain.

Chain Oiling.—A self-oiling device applied to bearings in pillow blocks, hangers, etc., in which a small endless chain hangs over the shaft and dips down into an oil cellar beneath the bearing, thus bringing up a little oil as it revolves.

Chain Pillars.—In mining, masses of rock left opposite each other on either side of a principal level or way, to support the roof against collapse.

Chain Pump.—A mechanical device for raising water, and thick liquids; an endless belt is provided with buckets like a grain elevator, and, as the buckets dip into the liquid, they each lift up a quantity which they discharge through a spout while turning over at the top pulley.

Chain Riveting.—In *boiler making*, where the rivets are placed in rows exactly opposite to each other; as distinguished from *zigzag* riveting.

Chain Stays.—In a bicycle frame, stays which counteract the pull of the driving chain.

Chain Tackle.—A system of pulley-blocks in which light chains supersede ropes. Called also *chain blocks*.

Chain Tongs.—A pipe-fitter's tool; a lever with a serrated end provided with a chain to enlase the pipe. The chain is wrapped around the pipe to hold the lever in place, and the teeth on the end of the latter grip into the pipe, thus affording a powerful leverage to screw or unscrew the joints.

Chain Wheel.—A suitably formed sprocket-wheel as used in connection with the transmission chains of cycles, motor cars, etc.

Chair.—In railway construction, a support for rails, bolted to the ties or sleepers. It consists of a cast-iron block with jaws into which the rails are keyed with wooden blocks, so that they are set at the correct gauge and inclination.

Chaldron.—A measure of 32 to 36 bushels; formerly employed with some kinds of coal; now seldom used.

Chalk.—A nearly pure carbonate of lime, soft and earthy in texture. It is of marine origin, composed of the shells and remains of minute organisms deposited in deep water; it is prepared and used for drawing or for marking purposes.

Chalk Line.—A light string or cord rubbed with chalk and stretched over any surface to mark a straight line. When the string is made taut, it is pulled up and let spring back, thus marking a white line on the surface as a guide for a needle or saw.

Chalybeate.—A term applied to waters which have iron in solution, it being present in the form of ferrous carbonate, dissolved by carbon dioxide. Some of the most famous springs and spas in the world are of this character.

Chamber.—1. In civil engineering, the space between the gates of a canal-lock.

2. In car building, an indentation on the inner surface of an axle-box to hold grease.

3. In dyeing, a form of apparatus for steaming printed cloths to fix the colors. It is about 9x12 feet and 9 feet high, the interior furnished with frames which run in and out upon rollers when the front door is open. The frames have cross-rods provided with tenter-hooks for suspending the cloths.

4. In a foundry, (a) the portions of a mould which contain the exterior form, and which are closed over the core in casting hollow-ware; (b) an enclosed space, as the fire-chamber of a furnace.

5. The interior space or cavity of a pump included between the inlet and discharge valves as distinguished from the cylinder.

Chambering.—In moulding, the operation of forming a recess within a hole, which has afterwards to be bored, by making the core larger in the middle. This obviates the necessity of boring the hole the whole way, as in a screw propeller or fly-wheel, gives a better chance to fit the shaft, and makes a stiffer core in moulding, not so likely to bend or wash up.

Chamfer.—In building, a beveled edge applied to corners otherwise rectangular by removal of the arris.

Chamfer Stop.—In construction, a shaped brick, which affords transition from a chamfer to an angle.

Chamois Skin.—A soft fine leather prepared from various skins, by splitting and dressing them with fish-oils. It is

used for polishing purposes, and for wrapping polished metals. This material also known as *wash-leather*, derives its name from the *chamois*, a goat-like antelope of the Alps, from whose skin it was formerly prepared.

Champlevé.—A class of enamels on copper, of which the celebrated Limoges enamels are typical. The parts to be enameled are scooped out as hollows in the metal, the sunken parts filled with the enamel and the whole ground smooth and level after fusion. Limoges enamels are noteworthy for a profusion of gold laid on them.

Chance.—1. In mathematics, probability.
2. To occur accidentally; not pre-arranged; as, a *chance* acquaintance.

Chandelier.—A frame with branches to hold candle-sockets; also an ornamental arrangement of pipes and figures to hold devices for lighting.

Change.—1. To alter; to make different; to cause to pass from one state to another; as, to change the position, character, or appearance of a thing.

2. To alter by substituting something else for, or by giving up for something else; to change one's occupation.

3. To give or receive in exchange smaller denominations of money; as, to *change* a gold coin or a bank bill.

Change Pump.—A pump introduced by the successors of Boulton and Watt in connection with the boilers of sea-going ships, in order to keep a continual change in the body of water, removing the super-salted water and substituting ordinary sea-water.

Change-speed Gear.—In an automobile, a number of pairs of cog or friction wheels, to produce different ratios of driving wheel speeds to engine speeds.

Change-speed Lever.—In an automobile, a hand lever by which are thrown into gear, either of the three or four trains of speed gears for forward running or the double train for reversing the motion.

Change Wheel.—In machinery, change wheels have varying numbers of teeth of the same pitch, and are used to connect the main arbor of the lathe with the feed-screw, so as to vary the relative rates of rotation and consequently the pitch of the screw to be cut.

Changing House.—In mining, tunneling, etc., a place set apart where the men change their clothing on going to or coming from the workings.

Channel.—1. The hollow bed where a stream of water runs or may run.

2. The deeper part of a river, harbor, strait, etc., where the main current flows, or which affords the best and safest passage for vessels.

3. That through which anything passes; means of passing; conveying or transmitting.

4. In structural ironwork, an iron bar or beam having a section resembling a flat gutter or channel.

Channeler.—A mining or quarrying machine, for cutting grooves, or making artificial seams in beds of stone, so that blocks may be easily detached.

Channeling.—In metallurgy, grooving or furrowing of the lining of a blast furnace, caused by certain impurities in the ores.

Channeling Tool.—A tool used for cutting a channel near the edge of a piece of leather, so as to hide the sewing. Used in making round work, such as running reins, whips, also in sinking grooves in shoe soles to hide the stitching. The cutter is adjustable on the shank, for penetration, and the guide at the end is to gauge the distance of the channel from the edge of the leather.

Channel Iron.—1. A form of angle-iron having a web with two flanges extending only on one side of the web.

2. In building construction, a brace or hook to support the guttering.

Chantlate.—In building construction, a projecting part of the roof-sheathing at the eave, to carry the drip clear of the wall.

Chapel.—In typography, a gathering or trades-union of the persons employed at a printing office. The name is supposed to date from Caxton's time when the presses were set up in Westminster Abbey. The leader, chairman or spokesman is known as the *Father of the Chapel*.

Chapelet.—1. In civil engineering, a dredge or water raising machine, consisting of a chain provided with scoops or scuttles, or with pallets traversing in a trough; the chain moving over rollers or wheels of which the upper one is driven by power, and the lower one is vertically adjustable, so as to regulate the position of the scoops or pallets, to bring them against the mud to be lifted or to submerge them in the water to be raised.

2. A French name for the *chain pump*, in which the cushions or buttons which occur at intervals on the chain are compared with the beads of the rosary. Hence also known as *paternoster pump*.

Chapeling.—In seamanship, wearing a ship round without bracing her fore yards.

Chaplets.—In moulding, fastenings or rails of wrought or cast-iron (of copper in brass-founding) used to support the cores in a mould, when necessary to be done.

Chapter.—1. A division of a book or treatise.

2. An organized branch of some society or trades union; as, a chapter of the printers' union.

Char.—1. Work done by the day; a single job, or task; a chore.

2. To work or hew, as to char stone.

3. To reduce to coal or carbon by exposure to heat; to reduce to charcoal; to burn slightly or partially, as to *char wood*.

Characteristic.—Pertaining to, or serving to constitute the character; or distinctive qualities or traits, of a person or thing; peculiar; distinctive.

Charcoal.—Impure carbon obtained from the imperfect combustion of animal and vegetable substances while air is excluded. Wood charcoal is generally made by stacking the logs or billets in the form of a beehive, with a central hole on top, while the outside is covered with turf, or a mixture of charcoal dust, *bricke*, and earth. The combustion is conducted from the top downwards and from the outside inwards, being regulated by the size, number, and position of holes in the outside covering.

Charcoal Filter.—A filter charged with ordinary or animal charcoal for domestic use, or with animal charcoal for use in a sugar refinery. The filter for the removal of feculent and other matters held in suspension in the clarified cane-juice is a high cylindrical vessel charged with bone black. Upon the perforated bottom, a filter cloth is spread, and upon this a layer of bone black is tightly packed; over this, the main body of animal charcoal is piled in loosely. Another cloth and perforated plate completes the column. The operation removes vegetable coloring matter, excess of lime derived from the clarifying, mineral salts, and particles in a fermenting stage.

Charcoal Hammered No. 1 Shell Iron. (C. H. No. 1 S.)—This, although not necessarily hammered, has been worked up before it is rolled into plates. It has a tenacity of 50,000 to 55,000 pounds per square inch in the direction of the fiber. It is rather hard iron, and should not be flanged. It is often used for the outside shell of steam boilers.

Charcoal Iron.—Wrought iron made solely with charcoal as fuel. This gives the best and purest iron, of great value in electrical work for transformer-cores, armature-discs, etc.

Charcoal No. 1 Iron.—(C. No. 1) is made of charcoal iron. It has a tenacity of about 40,000 pounds per square inch in the direction of the fiber. It is hard, but not very ductile, and should never be used for flanging.

Charge.—1. In smelting, the body of ore, metal, fuel, or other matter introduced into a furnace at one time, for one heat, or one run as the case may be.

2. (a) The charge of a *puddling furnace* is about 500 pounds of pig iron, and this forms 4 blooms; (b) the charge of a *gas retort* is 220 pounds introduced in two scoopfuls of 110 pounds each; (c) the charge of a *tumbling box* is as many castings or other matters as it will conveniently contain and give room for mutual attrition.

Charge Hand.—The leading workman of a gang; a working foreman. The term generally denotes the leading hand of a number of men engaged on fellowship piecework, as in erecting an engine, etc., and the one with whom the contract is made. Also known as *leader*.

Charging.—1. In a foundry, the supplying of furnaces with their ores and fuels.

2. In steam engineering, the priming or *fetching* of a pump with water.

3. In construction work, the dumping of concrete ingredients in the hopper of a concrete mixer.

Charging Scoop.—The regular scoop shovel, commonly called a coal shovel, but known to railroad men and others, as a *locomotive* or *charging scoop*.

Charging Station.—A depôt where accumulators of electric vehicles, launches, etc., are charged with electricity.

Charles's Law.—In physics, the law that the volume of all gases varies as their absolute temperature, under constant pressure. Also known as *Gay-Lussac's Law*.

Charles's Wain.—In astronomy, the group of seven stars, commonly called the *Dipper*, in the constellation *Ursa major*, or Great Bear.

Char Oven.—A furnace for carbonizing turf.

Charring Chisel.—A broad niggling-chisel, used in charring or hewing stone.

Chart.—A map or plan of the sea, or of harbors and rivers communicating with it. It contains the outline of the coast, with all navigation marks, and shows soundings and submarine dangers.

Charter.—In navigation, to hire a ship, either for a particular voyage, or for a time.

Charter Party.—In contract work, a divided charter; from the practice of cutting the instrument of contract in two, and giving one part to each of the contractors.

2. In shipping, a mercantile lease of a vessel; a specific contract by which the owners of a vessel let the entire vessel, or some principal part of it, to another person to be used by the latter in transportation for his own account, either under their charge or his own.

Chart Room.—A house or room on the bridge of a steamer where charts are kept or exposed for reference.

Chase.—To turn metallic objects in the lathe by means of hand-tools instead of those fixed in a slide rest; more especially to form screw-threads in or upon articles by means of comb-tools, termed *chasers*.

Chasers.—In shop practice, comb-tools used to make screw-threads upon metallic articles, or to finish off threads already formed by a slide rest tool. Hand chasers are made with the teeth parallel to the stock, or have the teeth at right angles to the stock. The *dies* used to form threads in automatic screwing machines or in pipe and bolt threading machines are also chasers.

Chasing Chisel.—A punch used in chasing. The mallet by which it is driven is the *chasing hammer*, and the operation is performed on a stake.

Chasing Lathe.—A type of lathe much used for *brass-finishing*, which has a chasing bar driven by variable *hobs* on a stationary nut so that the travel of the slide rest which is attached to the bar shall always be equal to the desired pitch. The slide rest carries inside or outside chasers to suit the work, and is brought into action by pulling its lever forward, partially rotating the chasing bar and bringing its nut upon the threaded hub or sleeve; moving the lever in the reverse direction throwing the chasing bar out of gear and instantly stopping its advance. With this device threads may be cut more rapidly and by a less skillful workman than with a single tool in the ordinary screw cutting lathe.

Chassis.—1. In military engineering, a base frame on which a casemate-gun is run in or out of a battery.

2. In automobile construction, a rectangular framework of iron or steel directly supported on springs attached to the front and rear axles, forming the *running gear*.

Chatter.—To utter rapidly, idly, or indistinctly.

Chattering.—A wavy jumpy cut made, instead of a clean one, by a machine tool, due to want of rigidity on the part of the cutting tool. It may be occasioned by a weak or too wide a tool, or by its projecting too far from the rest or tool post.

Chauffeur.—A French term, signifying a locomotive fireman, which has come into general use as designating the *driver* of any type of automobile.

Cheap.—Having a low price on the market; of small cost or price, as compared with the usual price, or the real value; common.

Cheat.—1. An act of deception or fraud; that which is the means of fraud or deception.

2. A fraud; a trick; imposition; imposture; swindle.

Check.—1. To hinder or restrain; to stop or prevent from advancing.

2. The act or means of preventing, restraining or controlling.

3. Any means taken to prevent mistake or fraud, as in making tallies or vouchers to see that various items correspond properly, or in independent calculations to test the accuracy of those already made.

4. A counter register of any document, or counterfoil of such things as requisitions, baggage tickets and the like.

5. Any piece or device intended to control or restrain motion.

6. The feed check-valve of a boiler.

7. An alternative spelling of *cheque*, a written order on a bank to pay money.

Check Chain.—In railway work, a chain connecting the body of a car with the corner of a truck, to prevent the latter swinging crosswise the car in case of accident.

Checkers.—1. Projecting ridges forming rectangles or lozenges on plates of metal, as for the floors of engine rooms or stove holes. Such floorings are termed *checker plates*.

2. An open work or lattice like arrangement of fire bricks through which hot gases, etc., pass in a *regenerative furnace* or in a blast furnace *stove*. Also known as *checker work*.

Check Hook.—A device in hoisting and lowering apparatus, designed to stop the motion of the wheel over which the rope runs, if the machinery becomes unmanageable. On the pulley are hooks which fly out by centrifugal force, when the speed becomes excessive, and engage stop pins which arrest the rotation of the pulley and the descent of the cage.

Check Nut.—A nut placed in contact with the main nut on the same bolt to keep the main nut from turning. More generally termed *lock nut*.

Check Rail.—On railways, a guard rail, mounted close to the running rail to prevent derailment of cars or engine when running through switches, around curves, etc.

Check Ring.—In engineering, a ring with set-pins which prevents the nuts of a bearing bolt from slacking back. Also called *guard ring*.

Check System.—The common method of keeping workmen's time, as followed in most large factories. Various modifications of the general system exist, in connection with automatic clocks, etc., but the general idea remains the same. The workman is supplied with two or three checks, one for each time of starting work, and these he drops into a box, or hangs upon a numbered board, thus enabling the timekeeper to see if he has come into work or not. In other cases, the man may take up the number off the board as he goes in, and place it in the box. The practice constitutes a *check* upon the time booked to each man or to each job upon which he works.

Check Valve.—An automatic or *non-return* valve used to control the admission of feed water into a boiler, etc. The pressure within the boiler keeps the valve upon its seat unless overcome by superior pressure caused by the pump or injector, thus permitting feed water to enter while preventing escape of the contents. Check valves on marine and other boilers sometimes have adjustable lifts, controlled by a wheel and spindle, but with the locomotive are generally non-adjustable, as only one boiler has to be considered.

Check.—In moulding, a supplementary or intermediate flask put in between the cope and nowel, in deep castings.

Cheese Press.—A machine used to extract the whey from curds in cheese-making. There are two kinds—(a) in which a vacuum is created below the cheese-*hoop*, and the whey driven out by pressure of the atmosphere; (b) the one in more common use, in which screws, toggle joints, etc., are used to secure the required pressure.

Chemical Action.—The action taking place when a single substance or a number of substances re-act so as to produce a new substance or substances as distinguished from a *mechanical mixture*. The nature of the action may be dependent upon various conditions, as temperature, pressure, mass, light. An important phenomenon is that heat is either produced or absorbed by every chemical re-action. At very low temperatures, as about -300° Fahr. chemical action seems to cease.

Chemical Affinity.—The force which is exerted between molecules not of the same kind. To affinity is due all the phenomena of combustion, and of chemical combination and decomposition. Also called *chemical attraction*.

Chemical Compound.—In chemistry, a union of two or more ingredients, in definite proportions by weight, so combined as to form a distinct substance; as, water is a *compound* of oxygen and hydrogen.

Chemical Fire Engine.—A fire extinguisher, on a large scale, mounted upon wheels and horse-drawn. It is very effective in quenching outbreaks of fire on account of its constant readiness and celerity of movement. It throws a stream of water and carbon dioxide under pressure, the gas, which effectually checks combustion, being generated in the apparatus itself by a jet of dilute sulphuric acid on sodium carbonate.

Chemical Formulae.—Groups of chemical symbols, each of which indicates the composition of one molecule.

Chemically Pure.—Without the admixture of any foreign substance whatever, such as could be detected by chemical tests. *Chemically clean* means cleaned by chemical means so that no dust or trace of any foreign substance remains on a surface.

Chemical Pulp.—In paper making, pulp prepared from wood, generally poplar or aspen, by treatment of the disintegrated fibers with *caustic soda* or *bisulphite of lime*.

Chemicking.—In bleaching, the process of steeping goods in a dilute solution of chloride of lime in stone vats, the liquor being continuously pumped up and strained through the goods until the action is complete. This precedes the souring which sets free the chloride.

Chemistry.—That science which treats of matter as composed of *atoms*; of the composition and decomposition of substances and the changes caused by their actions upon one another.

Cherry.—The wood of the cherry tree. In Europe and Asia, it is that of the cultivated tree, in North America, that of the wild black cherry. The latter variety has a fine, straight grain; it is hard, strong, and easily worked, being employed in turnery, cabinet work and interior finish.

Cherry Red.—In tempering, a bright red heat at which steel is generally worked. It corresponds to about 1650° Fahr.

Chest.—1. A large box of wood, or other material, having, like a trunk, a lid, but

no covering of skin, leather or cloth, and used for storing tools; as, a carpenter's tool chest.

2. In machinery, a tight receptacle or box, usually for holding gas, steam, liquid, etc.; as, the *steam chest* of an engine; the *wind chest* of an organ.

Chestnut.—A tree found in several varieties throughout the temperate regions of the world. The Chestnut grows in the Eastern U. S. reaching its best development on the western slope of the Allegheny Mountains. Its wood is light, soft, easily split but very durable in exposed places; it is used occasionally in cabinet-work, but not in joinery; chiefly for railroad ties, posts, fencing, etc.

Chief.—1. The head or leader of any body of men; a commander; a head man; a person in authority, who directs the work of others: the principal actor or agent.

2. The principal part: the most valuable portion.

Chief Engineer.—The chief of a staff of engineers, as of a steamship.

Chill.—1. The casting of iron and steel in a metallic mould, which is kept cool by the circulation of water within it. Only certain varieties possess the property of chilling, but when successfully carried out it results in a very hard skin on the casting, the depth of which is sometimes as great as $\frac{1}{4}$ " to $1\frac{1}{2}$ ". Rolls for metals, or flour mills, shoes and mortars for ore stamps, plow shares, projectiles, and cast-iron wheels for railroad cars are usually made by this method.

2. Reduction of temperature stopping short of actually freezing.

Chilled Rolls.—Cast-iron cylinders, either plain, or grooved, used in pairs to form patterns or sections, such as are used in rolling metals into sheets, plates or bars; also employed in flour mills, etc. They derive their name from being cast in a chill to harden them.

Chilled Wheels.—In railway work, wheels for cars are frequently made of solid cast iron to avoid the expense of tires. In this case, the tread is cast in a *chill* which penetrates from $\frac{1}{4}$ to $\frac{1}{2}$ inch.

Chilling Rooms.—In steamships, an insulated refrigerating compartment especially constructed for the storage or transport of meat or fruit; the temperature is maintained a few degrees above 32°, instead of freezing the provisions as in ordinary cold storage. Beef and mutton carcasses will keep fresh and sweet for 24 to 30 days, and the quality of the meat is not impaired as by freezing; while delicate tropical fruits are carried in excellent condition.

Chime Whistle.—A steam whistle so arranged that the note it produces is a proper harmonic chord.

Chimney.—1. In mining, a rich portion of a vein, particularly when running more or less vertically.

2. The vent or passage through which smoke and products of combustion are carried to the open air. Its action depends upon the difference in weight between the column of heated gas in the chimney and that of a similar column of the external air. Consequently, other things being equal, the higher the chimney the more powerful the draught.

Chimney Cap.—A curb or cap of cast iron placed around the top of a chimney, to stiffen it and also for finish. Masonry caps are placed around the chimneys of ordinary buildings.

Chimney Pot.—A tube of pottery or sheet metal to extend a flue above the chimney shaft. They are sometimes ornamental and made to agree in design with the character of the building.

Chimney Shaft.—The part of a chimney above the roof.

China Clay.—An extremely pure form of clay, resulting from the decomposition of potash feldspars, deriving its name from its employment in the manufacture of *china* or porcelain; it is largely used as a filler in the manufacture of paper, also as a weighter for cotton goods. See also *kaolin*, *porcelain*, etc.

Chine.—In cooperage, the edge or rim of a cask, etc., formed by the projecting ends of the staves; the *chamfered* end of a stave. Also called *chime*.

Chinese Ink.—The finest quality of the ink which generally goes under the name of *Indian Ink*. It is used largely for mechanical drawings. Chinese-ink dries glossy; India ink dries a dead black.

Chinese Wax.—A white solid wax, imported from China. It is secreted by a wax insect, much resembling the cochineal insect, and deposited upon the leaves of certain plants, whence it is collected by scraping and boiling.

Chinese Windlass.—An adaptation of the wheel and axle, in which two barrels of different diameters are mounted on the same axis. The rope or cord is so attached that it is wound off one barrel as it is wound on to the other. This gives a slow motion but considerable mechanical gain, and is the fundamental principle of the well known *differential pulley block*.

Chink.—1. A small cleft, rent, or fissure, of greater length than breadth; a gap or crack; as, the *chinks* of a wall. To crack; to open.

2. To cause to make a sharp metallic sound as with coins, small pieces of metals, etc., by bringing them into collision with each other.

Chinsing Iron.—A calking tool used to *chinse* or temporarily calk the seams of a vessel, etc., with oakum.

Chip.—In navigation, a piece of wood of the shape of a quadrant, of 6 inches radius and $\frac{1}{2}$ inch thick, placed on the end of a log line. The chip is loaded at the circular edge so as to float upright, about two thirds being immersed in water. The knotted log line is wound on a reel, and the chip or log being thrown overboard catches in the water and remains about stationary there while the cord unwinds as the vessel proceeds. The number of knots passing the seaman's hand while the sand in the half minute glass is running out indicates the number of knots or nautical miles per hour of the vessel's speed.

Chip Break.—A piece that rests upon the work of a wood-working machine and prevents the cutter from splitting out the wood as the cut leaves the surface.

Chip Breaker.—The metal plate placed at the front of the bit of a carpenter's plane to prevent the splitting of the board by bending up the chip.

Chipping.—The act or process of dressing metallic surfaces by means of a hammer and chisel, the metal being removed in small particles or chips. This is especially resorted to, either when a considerable amount of material has to be cut away or it is necessary to remove the *skin* of a forging or casting; in either case chipping is preparatory to *filing* and expedites the latter operation.

Chipping Face.—In foundry practice, the face of the narrow and thin metal strips cast around the edges or across the face of those portions of castings where a good face bearing is necessary, the casting having its bearing upon the faces of strips only. They are used to lessen the labor of fitting large metallic surfaces.

Chipping Hammer.—A fitter's hammer weighing about a pound, commonly used to deliver the blows upon the head of a chipping chisel.

Chipping Knife.—A heavy knife used by plumbers for cutting up lead; it is used by hammering on its back.

Chipping or Cold Chisel.—In construction work, a tool used by all mechanics. It is made from steel rod, ranges from four to fifteen inches in length; its cutting face is ground to a double bevel to an angle of about forty-five degrees, and is highly tempered.

Chipping Piece.—1. In a foundry, an elevated cast or forged surface, affording surplus metal for reduction by chipping.

2. The projecting piece of iron cast on the face of a piece of iron framing where it is intended to be fitted against another.

Chipping Strip.—In engineering, a raised edge around the abutting parts of machinery, so that the labor of fitting them shall be considerably lessened, the chipping and filing taking place only on the *chipping strip* or raised margin instead of the whole abutting surface. Especially used where castings are bolted together to form framing, etc.

Chisel.—An instrument of iron or steel, sharpened to a bevelled cutting edge at the end, used in carpentry, engineering, masonry, and most other trades, either for paring, hewing, or gouging.

Chisel Draft.—In masonry, in squaring the end of a stone block, one edge is *chisel dressed* to a straight edge and forms a base for the determination of the other sides.

Chisel-tooth Saw.—An inserted tooth saw, having chisel like bits for teeth, as used in large circular saws.

Chit.—1. A small tool used in cleaving lathes.

2. To shoot out, to sprout.

Chlorate.—A salt of chloric acid. All chlorates are soluble in water; on heating they evolve much oxygen and a trace of chlorine, the residue being a chloride. On account of their oxidizing properties chlorates are much used as reagents, and in the compounding of explosives, fireworks, matches, etc. The most important are the chlorates of borium, potassium and sodium.

Chloride.—A compound of an element with chlorine. The chlorides of non-metallic elements are either gaseous or liquid, those of metallic elements are liquids or solids. Some of these latter are decomposed by water, all the remainder save those of silver and some of mercury are soluble in water. A chloride is formed by direct union of the elements; by decomposition of a metal or its oxides or carbonate in hydrochloric acid; or by double decomposition, as with an insoluble chloride, such as that of silver.

Chloride of Antimony.—A strongly acid liquid of a reddish brown color, formed under heat by the action of hydrochloric acid upon native sulphides of antimony. This is really a solution of the *terchloride* in hydrochloric acid. Upon concentration the *terchloride* becomes a soft solid known as the *butter of antimony*; this is used with olive oil to bronze gun barrels, etc., and is also used by electroplaters as an oxidizing agent for silver, etc.

Chloride of Copper.—A white crystalline solid, insoluble in water but soluble in hydrochloric acid and ammonia. This salt is used in electroplating, etc.

Chloride of Gold.—This is formed by the action of aqua regia, or nitro-hydrochloric acid upon gold. The chloride is readily soluble in various liquids, is extremely susceptible to light, and is consequently much used in photography. It is also employed in electro-deposition.

Chloride of Lime.—Calcic chloride, prepared by passing chlorine gas over slaked lime in a gradual manner to avoid heating it. The chloride is used as a bleaching agent, as a disinfectant for the formation of brine used in refrigerating systems.

Chloride of Silver.—Formed as a precipitate by treating silver nitrate with chloride of sodium. It is extremely sensitive to light and is used to prepare the sensitive paper upon which photographs are printed from the negative. The chloride is also used by electroplaters in silver solutions.

Chloride of Tin.—In chemistry, a compound of chlorine with tin.

Chloride of Zinc.—A white solid, usually seen in the form of sticks, prepared in solution by the action of hydrochloric acid on zinc. This solution is generally known to tinsmiths as *killed spirits*, and is largely used in soldering with lead and tin alloys.

Chlorination.—In smelting, a process of reducing quartz or pyritical gold ores in which, after a preliminary roasting with salt, the ore is placed in a suitable vessel to be attacked by chlorine gas, converting the gold into a soluble chloride, which is removed by washing with water and subsequently precipitated by sulphate of iron.

Chlorine.—A non-metallic element; a yellowish-green gas, very heavy (2.5 times the weight of air), with a peculiar irritating smell and very active chemical properties. Its atomic weight is 35.45, and it

liquefies at -23.2°F. , being the first gas to be so treated. It unites with all metals and most non-metallic elements to form chlorides; water is decomposed by it under the influence of light, forming hydrochloric and hypochlorous acids. As a reagent, with most organic compounds, it displaces the hydrogen, adds itself to the compound or else liberates the carbon. Its chief uses are in *bleaching*, by virtue of its action on water, the liberated oxygen being the actual bleaching agent; in extracting gold; in the preparation of organic compounds; as a disinfectant, walls being washed two or three times with a one per cent. solution.

Chloroform.—A volatile, colorless liquid of sp. gr. 1.497, with a sweetish taste and a pleasant characteristic odor, boiling at 142°F. It is readily soluble in alcohol and ether, and slightly so in water. It is an excellent solvent for many organic substances, and is a powerful anæsthetic when inhaled. Commercial chloroform is obtained by distilling a mixture of rectified spirits, chloride of lime, and bleached lime.

Chock.—1. A wedge usually made of wood, used to prevent motion or as a support.

2. On a boat, a metal casting or piece of wood fastened to the deck and having jaws to guide the *painter*.

Chock-a-block.—When, in lifting by means of a tackle, the upper and lower blocks are drawn close together, they are said to be *chock-a-block*.

Choke.—To obstruct by filling up or clogging a passage; to block up; to hinder or check expansion or progress; to stifle.

Choke Bore.—In firearms, a manner of boring the barrels of shot-guns. The bore is contracted by a ridge or swelling near the muzzle, being cylindrical for the remainder of its length, thus causing the pellets to fly in a clump and giving harder hitting powers. The same results are attained with a *drawn bore* in which the barrel is drawn to a uniform taper, the decrease at the muzzle, however, being very slight.

Choke Damp.—A gas formed in coal-mines from coal or in other ways; it cannot be breathed and is inimical to life, hence its name.

Chop.—1. A jaw; commonly in the plural; as the jaws of a carpenter's bench-vice.

2. To cut by striking repeatedly with a sharp instrument; to cut into pieces; to mince; to sever or separate by one or more blows.

3. Coarsely ground or broken grain, consisting of bran, flour and middlings. The first product in ordinary burr milling.

Chopping Block.—A solid block of wood on which butchers or others do their chopping.

Chopsink.—A shop-term to denote a mark left on a plate by a sawmaker's or plate straightener's hammer.

Chord.—1. In geometry, a straight line uniting the extremities of an arc of a circle or a curve.

2. In civil engineering, the upper or lower part of a truss, usually horizontal, resisting compression or tension; as, the upper and lower chord of a Howe Truss bridge.

Chordal Pitch.—The pitch of a toothed wheel measured along the *chord* cut-off or the pitch line by the center line of two adjacent teeth. This is seldom employed, *arc pitch* or the pitch measured around the circumference of the pitch line being generally used. With machine cut wheels the *diametral pitch* is more often used.

Chromate of Lead.—A rare mineral found in Siberia, Hungary and the Philippines. It is known better as *crocoite* and is found in translucent yellow crystals. *Chrome yellow* is derived from this substance, which is also used in organic analysis and electroplating.

Chromatic.—1. Relating to color or to colors.

2. In music, a series of notes progressing by semi-tones.

Chrome Steel.—Steel containing 1.2 to 1.5 per cent. of chromium, which confers upon it extraordinary hardness and tenacity, rendering it suitable for projectiles, armor-plates, safes, etc.

Chrome Tanned.—Leather which has been tanned with *chrome salts* instead of by the agency of vegetable materials. Heavy harness and driving belts are usually tanned by this means, in gradually weakening solutions of a basic chrome salt, the process taking only eight or nine days. The process for lighter leathers is to steep them in a solution of bichromate of potash, to which is added hydrochloric acid to liberate the chromic acid. This enters into the leather and turns it a deep yellow, upon which the skins are placed in a sulphuric acid solution which turns the leather greeny white, changing the acid into chrome oxide and other salts. After washing to free of acid, the leather is *skived-split*, *fat-liquored*, and *died* with aniline to the desired shade, *stretched* and *glazed*.

Chromium.—A white metal, very infusible, with a specific gravity 6.8 principally occurring in nature as *chrome iron ore*, which is found in the Shetland Islands, Bosnia and California. Alloyed with steel in small quantities, it produces a material of extreme hardness and tenacity, and its compounds and derivatives are numerous and useful. *Chrome alum* is employed in dyeing and calico printing; *bichromate of potash* is used for electrical purposes, as a pigment, and a tanning material; *chrome oxide* furnishes a fine green

pigment, and the *chromates of lead* provide a most useful yellow and a middle red; the various salts are all strong reducing agents and are employed as such in many other processes and arts.

Chromo Lithography.—The art of printing in different colors by means of *lithography*. A separate stone is used for each color, and shading and blending is accomplished by superposition of one color on another. The more delicate pictures require a great number of stones, each of which represents a distinct passage of the plate through the press.

Chromometer.—A laboratory instrument for determining various qualities or proportions of substances by their color. In metallurgy, the chromometer is applied to ascertain the proportions of a metallic substance by comparison of its *borax bead* with shades of color corresponding to known proportions. In classifying or refining *petroleum*, a similar instrument is utilized to observe the color of a definite amount of the oil as compared with that of glass slides of standard intensities.

Chronicle.—An historical register or account of facts or events disposed in the order of time.

Chronograph.—A timekeeping instrument of which the *stop-watch* is the most familiar instance. The mechanism can be set in motion by pressing a spring and stopped by the same means, thus preserving a record of the time elapsed between the two movements, as in timing a boat race, etc.

Chronology.—The science which treats of the measurement of time, fixes the true order of past events, their exact dates, etc.

Chronometer.—A finely made timepiece, whose balance wheel is specially adapted to keep accurate time in all variations of temperature. It has an escapement, more refined than that of a watch. For marine use, the chronometer is mounted on *gimbals* to preserve it from vibration and keep it horizontal. Chronometers are mounted in boxes, which are enclosed in a glass covered case, preserving them from dust, draughts and fluctuations of temperature. They are wound daily at a stated hour and are not regulated. The instrument is set as accurately as possible and its timekeeping qualities ascertained in an observatory. A certificate of *rating* is issued showing the *gain or loss* of the chronometer, and this cumulative error is taken into account when observing the time.

Chronoscope.—An instrument for measuring extremely short intervals of time, as in the flight of a projectile. It consists of a series of wire screens through which the ball passes, making and breaking electric contacts which are recorded on the chronoscope. This is simply a large stop-watch made to beat to a very small fraction of a second instead of the 4 or 5 beats to the second of the ordinary chronograph.

Chuck.—1. A contrivance fixed to the mandrel of a turning-lathe for holding the material to be operated upon.

2. To place in a chuck, or hold by means of a chuck, as in turning.

Chucking Machine.—In machinery, a turret lathe in which the fast head is fitted with a chuck to hold articles to be operated upon; also a smaller type of vertical boring mill, in which the tool rest is carried on a vertical ram working on an overhanging pillar similar to a slotting machine, rather than on a cross rail between two pillars as in the larger types: with the chucking machine, it is customary to furnish the tool slide with a turret head, carrying a variety of tools.

Chuck Lathe.—A lathe in which the work is held by a socket, or grasping device, attached to the revolving mandrel of the head stock. It is used often for turning short work, such as cups, spools, balls, and a variety of ornamental and useful articles.

Chum.—A shop term for a fellow workman, one who works in the same room and is intimate; a roommate, or an old and intimate friend.

Churn Valve.—In hydraulics, a by-pass or circulating valve, fitted to the water ends of steam fire engines or other pumps, leading from the discharge to the suction side. This fitting permits the pumps to be got under way against a stiff head, or lets the pumps run while deliveries are closed for some reason. It is necessary to close the valve when first priming or when standing, so as to hold the water.

Chute.—A rapid descent in a river; an opening in a river-dam for the descent of logs, etc.; a framework or tube through which articles are made to slide from a higher to a lower level.

Chute Case.—An annular casing surrounding certain types of turbine water wheels. The chute case contains the guide blades of one of the inward flow type, and is sometimes made double, the inner case acting as a *register gate*, to regulate the flow of water.

C. I. F.—A commercial transportation term, meaning *cost, insurance, and freight*; it is intended to cover the cost of certain goods at point of destination.

Cinder.—1. A small particle of matter remaining after combustion.

2. A scale thrown off in forging metal.

3. Uncombined carbon in wrought iron.

Cinder Chute.—In locomotives, a funnel shaped pipe beneath the smoke box, for emptying the cinder pocket. Also called *cinder hopper*.

Cinder Pig.—In metallurgy, an inferior variety of pig iron obtained by remelting the slags and cinder of puddling and reheating furnaces; the slags are rich in iron oxides and also possess much phosphorus and silicon, resulting in a poor metal, as that quality used for sash-weights.

Cinnabar.—The native sulphide of mercury, consisting of 86.2 mercury and 13.8 sulphur. It occurs in dark red crystals or massive in darker colored shale-like masses, forming the most important ore of mercury. Found in Almaden in Spain, in Mexico, California, etc. *Vermilion* is prepared from this sulphide.

Cipher.—1. In arithmetic, a character which standing by itself expresses nothing, but when placed at the right hand of a whole number increases its value *tenfold*.

2. A character in general, as a figure or letter.

3. A combination of interweaving of letters as the initials of a name, a device, a monogram.

4. A private alphabet, system of characters or other mode of writing, contrived for the safe transmission of secrets.

Ciphertunnel.—In building, a false chimney placed on a house for ornament or uniformity.

Circle.—A plain figure bounded by a uniformly curved line, all of the points in which are at the same distance from a certain point within called the *center*.

2. The fifth wheel of a carriage.

Circle Iron.—A hollow punch for cutting planchets, wads, wafers and circular blanks.

Circular Cutter.—A cutting tool used in connection with lathe tool holders, when it is desired that the form of the cutting point remain unchanged. The cutter is turned up to the desired profile of rim, and a notch formed in it so that it resembles a milling cutter with one long tooth, and until the tool is quite worn away it always maintains the same section. In use, it is bolted to the side of a tool holder and held rigidly.

Circular Inch.—The area of a circle whose diameter is one inch; as distinguished from one square inch, and equals .7854 square inch. The circular inches in any circle is simply the *diameter in inches squared*.

Circular Measure.—This is used for measuring angles.

TABLE.

60 seconds (")	make 1 minute, '.
60 minutes,	1 degree, °.
360 degrees,	1 circle, C.

The circumference of every circle, whatever is supposed to be divided into 360 equal parts, called *degrees*. A degree is $\frac{1}{360}$ of the circumference of any circle, small or large. A *quadrant* is a fourth of a circumference, or an arc of 90 degrees. A degree is divided into 60 parts called *minutes* expressed by sign ('). and each minute is divided into 60 *seconds* expressed by ("). so that the circumference of any circle contains 21,600 minutes, or 1,296,000 seconds.

Circular Motion.—In shaping and slotting machines, the feed mechanism whereby the work is rotated so that it may be shaped to circular arcs; as, with the ends of levers, connecting rods, etc.

Circular Pitch.—The pitch of wheel teeth as measured along the circumference of the *rolling or pitch circle*, upon which one wheel comes into contact with its mate. Also known as *circumferential pitch*.

Circular Saw.—A disc of steel with saw teeth upon its periphery, and revolved on an arbor.

Circular Shears.—A cutting instrument for sheet metal consisting of two circular blades on parallel pins.

Circulating Decimal.—A decimal fraction in which a set of figures is constantly repeated as 0.214214....; when the recurring part consists of one figure only as 0.333... it is termed a *repeating decimal*. For brevity, the recurring portion is indicated by a dot over the first and last figures, as 0.2̇14, 0.3̇.

Circulating Pump.—1. In a steam plant, a reciprocating or centrifugal pump maintaining the circulation of cooling water through a surface condenser, either by suction or forcing.

2. A pump for maintaining a circulation of a liquid through any apparatus, as of brine through the coils of a refrigeration tank.

Circulation.—1. Motion in a circular course, or in one which brings the moving body back to the point whence its motion began.

2. In steam engineering, the provision of means within a boiler for the unobstructed motion of water from the coldest to the hottest part, thus aiding the passing of the feed water into steam. In raising steam, with large boilers having thick plates, forced circulation is employed when by use of the *hydrokineter* there is an auxiliary boiler in use. This prevents the great stresses thrown on the shell-plating by a considerable difference of temperature between the bottom and the top of the boiler, and also quickens the generation of steam.

Circumference.—The curved line that bounds a circle.

Circumferential Riveting.—The ring seams in a boiler; those riveted around the *girth* or circumference of the shell which unite the various strakes of plating together.

Circumferential Seam.—A riveted joint in a boiler-shell, running in the direction of the *girth*, or circumferentially.

Circumferentor.—A surveying instrument, much used under ground, and hence also called the *Miner's Dial*. It consists of a compass needle suspended at the middle of a graduated horizontal circle, the latter being furnished with a *vernier* for fine readings and *sights* for accurate observation.

Circumscribe.—In geometry, to draw a line around so as to touch at certain points; to hem in; to surround; to encircle.

Circumstance.—An event, a fact; a particular incident; detail; item.

Cire Perdue.—From the French, meaning *lost wax* (pronounced *seer perdoo*). A mode of making bronze castings, by making a pattern of the desired object in modelling wax, enclosing this in plaster of paris, melting out the wax when the plaster has set and using the plaster mould for casting the bronze.

Cis Atlantic.—In navigation, on this side of the Atlantic Ocean; used to denote the eastern or western side, according to the *standpoint* of the writer.

Cistern.—An artificial reservoir or receptacle for holding water, or other liquids.

Cistern Filter.—A cistern having a permanent chamber which has *filtering material* intervening between the supply and discharge.

Cistern Pump.—A small lift or force pump, for pumping water from a cistern of moderate depth.

Citizen.—One who enjoys the freedom and privileges of a city; a person, native or naturalized, of either sex, who owes allegiance to a government, and is entitled to protection from it.

Citric Acid.—A white crystalline solid with a very acid taste. It is present in lemons (whence the name), limes, currants, gooseberries, raspberries, etc., and is prepared from lemon and lime juice by boiling, adding chalk until effervescence ceases; the precipitated *calcium citrate* is collected, and decomposed with sulphuric acid, forming insoluble calcic sulphate and soluble citric acid; the products are filtered, and the filtrate is crystallized by evaporation as *citric acid crystals*.

Civil.—1. Observing the customs and proprieties of social life; as, a *civil answer* is expected to a proper question.

2. Pertaining to a city or state, or to a citizen in his relation to his fellow citizens or the state.

Civil Engineering.—That branch of engineering which deals with non-military public works. It embraces railways, roads, bridges, embankments, waterworks, harbor-constructions, canals, etc.

Civil Service.—Permanent employment under the government of a country in its public services, *excluding* the military, judicial or legislative branches.

Clack.—In millwrighting, a device in grain mills for ringing a bell when more grain is required to be fed to the hopper. A mill hopper *alarm*.

Clack Valve.—A pump valve which works on a hinge; generally the hinge and face are made of leather, the valve itself being of metal. So called from the noise it makes when seating itself.

Claim.—In mining, a specific area of mineral ground claimed, marked out, or held by an individual or association in accordance with local mining laws. Also water rights, for mining purposes, marked out in similar manner, adjacent to streams.

Clairce.—In sugar making, a saturated solution of pure sugar.

Clam.—1. To clog, as with glutinous or viscous matter.

2. To glue or stick; as, to *clam* paper to the wall.

Clamber.—To climb over, along, or down, by using hands and feet; as, we *clambered* over the loose stones.

Clamp.—1. To join and hold closely together, or to another piece.

2. A device for compressing or holding in position a piece or part, or holding or binding together two or more parts; usually with

jaws or cheeks, one of which is movable or has a moving part, so that they may be set together or closed by some device.

3. An arrangement for burning bricks, where the bricks themselves are so disposed as to form the furnace and flame passages. It differs from a *kiln* in that, with the latter, the furnace is a permanent structure, over which the bricks are arranged.

Clamp Coupling.—A species of compression coupling for shafting, consisting of a cylindrical piece with two internal clamps, which are tightened upon the shaft by means of taper pins or wedges operated from the end.

Clamp Dog.—A lathe dog or carrier having a pair of clamping jaws.

Clamp Nail.—In shipbuilding, a large kind of nail used to secure the clamps to the ribs of a ship.

Clamp Screw.—In carpentry, a joiner's implement on the bench, or to be attached to the work, to secure it to a table or for holding two pieces of material together.

Clamshell Bucket.—An excavating or dredging bucket, used in connection with a power crane, consisting of two semicircular valves, the curved edges of which scoop up the soil as they meet. It derives its name from a strong resemblance to the shell of the common clam.

Clapboard.—A narrow board, thicker at one edge than at the other; used as a weatherboard on the side of a house.

Clapboard Gauge.—In carpentry, a device used in putting on the weatherboarding of a house so as to leave a uniform width of face to the weather. The gauge takes its set from the lower edge of the board last nailed on, and has a stop for the lower edge of the board next above.

Clapper.—That part which strikes; as:

1. The tongue of a bell.
2. A piece of board to pat bricks to correct any warping when partially dried, in removing from the floor to the back.
3. A clack-valve.

Clapper Box.—The hinged part of the tool rest on a planer or shaper, permitting the tool to lift on the return stroke.

Clapper Valve.—In steam engineering, a valve suspended from a hinge and operating on two openings or seats alternately. In a modified form, it consists of a disk vibrating between two seats.

Clarifier.—1. An agent which purifies liquids; as, white of egg, isinglass or other substances.

2. In sugar refining, a metallic vessel in which cane juice is purified by heating and treatment with lime. It consists of a hemispherical copper *pan* and a cast iron jacket, the intervening space being filled with steam by a pipe.

Clash Gear.—The sliding change-speed gear of an automobile.

Clasp.—A catch, or flattened hook, for holding together the parts of anything; as, the ends of a belt, the covers of a book, etc.

Clasp Hooks.—1. A pair of hooks moving upon the same pivot, and forming mousings or lashings for each other.

2. A pair of tongs whose jaws overlap upon each other. The running ring is the *rein*.

Clasp Nail.—The ordinary cut nail; as used in all descriptions of wood work it has a tapering rectangular shank and a head longer than it is wide.

Classification.—Distribution into groups as classes, orders, etc., according to some common relations.

Classifiers.—In mining; sieves of various types, worked by hand or power, to sort pieces of ore according to size.

Classmate.—One who is in the same class with another, as at school or in an institution.

Clatter.—To make a rattling sound by striking hard bodies together; to make a succession of abrupt, rattling sounds.

Clause.—1. A separate portion of a written paper, paragraph, or sentence.

2. An article, stipulation, or proviso, in a legal document.

Claw.—In mechanics, part of a tool or implement bearing a resemblance to the claw of an animal; as, a claw hammer; the claw or hook of a crowbar.

Claw Coupling.—A species of clutch or disconnecting coupling in which projections on the faces of both the sliding and fixed parts engage in recesses in the other. Also known as *claw clutch* or *jaw coupling*.

Claw Hammer.—A hammer with one end of the head cleft or divided into two equal parts; used for drawing nails.

Claw Hatchet.—A hatchet whose *poll* is formed as a claw hammer, thus giving in one tool, hatchet, hammer, and claw for drawing nails. Used by shinglers, slaters, and in setting laths for plastering.

Claw Tool.—In masonry, a chisel with serrated edges used for dressing soft stones. Also known as *tooth chisel*.

Clay.—A widely distributed earthy rock, derived from the disintegration of harder rocks, such as *feldspars* or *granites*, etc. The natural silicate is commonly mixed with variable proportions of sand, lime, iron oxides, magnesium or other minerals, and sometimes with organic matter. The common characteristic feature of all clays, which vary so much in other respects, is *plasticity*, that is upon moistening with water clay can be moulded into any desired shape; if this added water be evaporated the clay may be reworked, but if sufficient heat be applied to drive off the natural constituent of the hydrated silicate, the clay is burnt into a solid substance, no longer workable; as, *brick*, *kaolin*, *pottery*, etc.

Clay Auger.—In well boring, a rotary cutter shaped like an imperfect tube with a cutting lip, used to remove clays or soft strata from the upper portion of a bore hole, before starting the striking drills.

Claying.—1. In sugar making, the process of crystallization in moulds, in which a lump of wet clay is laid upon the base of the inverted cone of wet sugar, to secure a more perfect drainage of the *coloring* solution.

2. In mining, lining the blast hole with clay, to prevent the explosive from becoming damp.

Claywash.—In foundry work, a mixture of clay in water, used by loam moulders.

Clean.—As generally understood it means free from visible impurities or from surface defects or blemishes. A clean casting is one without surface defects; clean timber is free from knots or bad spots; clean water is clear to the eye, although it may contain salts in solution.

Clean Boiler.—A steam boiler free from incrustation, scale, or muddy deposits.

Clean Casting.—In a foundry, a casting having a clean skin. To produce a clean casting, the mould must be properly vented, sand suitable for the nature of the casting must be used, and the surface *sleeked over* with plumbago.

Clean Cut.—A cutting tool is said to produce a clean cut when the cut surface is not grooved, wavy, or ridged, but continuous and smooth. The cleanliness of a cut depends on the proper cutting angle being maintained, on the degree of force applied to the tool; too much pressure causing rough cutting.

Cleaner.—1. In leather manufacture, a currier's straight two-handed knife, with a blade two inches broad.

2. In a foundry, a *sticker*, or tool used for smoothing surfaces in sand moulding.

3. In manufacture, one of a pair of small card cylinders, called *urchins*, arranged around the periphery of a card drum. The *worker* is the larger of the two; it takes the fiber from the card drum and delivers it to the cleaner.

Cleaning Eye.—In plumbing, a brass cap or cover screwed on to a lead trap, so that refuse may be removed by taking off the cover.

Cleaning Fires.—In steam engineering, the operation of removing clinkers, cinders, etc., from boiler furnaces at regular intervals. The fireman rakes the burning coal to one side of the furnace, throws a shovelful or two of round coal on the fire, and then proceeds to pull out the exposed clinker and dirt from the other side. The mineral matter is levered from the firebars by means of the *slice* and raked out, a trimmer quenching the clinker with water as it falls. The burning coal from the other side is now spread on the clean half of the bars, and the cleaning process repeated as the dirt is exposed on that side. As soon as the whole is clean, the fire is spread, fresh coal sprinkled on, and, as soon as this is properly ignited, the furnace is charged with coal as usual. A furnace requires cleaning generally once in 8 to 16 hours, depending on the coal and its method of combustion.

Clean Up.—In mining, the periodical cleaning up of all accumulated ore, as at a mill or smelter, so as to finish treatment of all received during a certain interval.

Clearance.—1. In machinery, the amount of space left between two parts that have to engage each other, as in wheel teeth, where it represents the difference between the thickness of a tooth and the width of the corresponding space.

2. The space between a moving and a stationary part, enabling the former to clear the latter; this is an arbitrary amount, to allow for possible inaccuracy in adjustment or the employment of rough instead of finished parts, as well as to allow of vibration play while running, or the effects of wear.

3. In steam engineering, the space between a piston, when at the extremity of its stroke, and the end of the cylinder wherein it works.

4. In navigation, a certificate given by a harbor-master to a shipmaster stating that the requirements of the law have been complied with, and giving permission to depart. The clearance bears the name of the ship, her master, to what port bound, and notes on her cargo. It is an indispensable legal document.

5. In a motor car, the height between the road surface and the lowest part of the underbody.

Clearance Space.—In a compressor, engine or pump cylinder this comprises not only the space left between the cylinder end and the piston but also the volume of the ports between the valves and the working barrel. In gas engines, etc., the clearance space serves as the combustion chamber and is necessary, but with steam engines it is sought to be minimized as with Corliss or drop valves. In any machine compressing a gas, its efficiency is much diminished by the effects of clearance, hence many devices are employed, especially with ammonia compressors, to reduce it to its least possible limits.

Clearing.—In calico printing, removing excess dye from the prints by washing, applying soap and bran; or *bleaching* in the open.

Clearing Hole.—In founding, a term used in opposition to *tapping hole*. It signifies a hole full to the specified size so that a turned stud or bolt of the same nominal diameter will pass freely, yet closely, through it.

Clearing Ports.—In shipbuilding, ports opening outwards only, fitted to a well deck, etc., to free it from water shipped in heavy weather, without permitting more to come through the side. In nautical language called *scuppers*.

Cleat.—1. A strip of wood or iron fastened crosswise to something for strength, to prevent warping.

2. A device made of wood or metal having two arms around which turns may be taken with a rope to hold securely and yet be readily released.

Cleating.—Plank covering or casing.

1. In civil engineering, the planking of a dam or cofferdam, or of a sea wall, secured to guide piles. Also the planking or skin of a canal lock gate.

2. In steam engineering, the wooden covering of a steam boiler or cylinder to prevent the radiation of heat. Also called *lagging*.

Cleavage.—The state of being cloven or split; the property possessed by many minerals of being easily split into thin sheets, generally in one uniform direction; noteworthy with various rocks, such as roofing *slates*.

Cleaver.—A heavy long-bitted chopping tool, used by butchers in cutting up carcasses. In the large packing houses it is generally used to the exclusion of other cutting tools, except in trimming.

Cleaving Knife.—A cooper's tool for splitting blocks of timber into staves; also called a *frow*.

Cleft.—Separated by cleavage or by splitting, instead of by sawing. This ensures that the grain of the wood is parallel with the length of the piece, and is specified for all tree nails, keys and wedges used in railway working, as well as for many other uses.

Clenching.—In carpentry and pattern making, the turning and hammering over of the points of nails against a wood face to secure their adhesion under rough usage. The clenching transforms the nails into rude clamps.

Clepsydra.—A water clock; an ancient device which measured time by the aid of a flow of water from a minute orifice. The passage of the hours was indicated either by the sinking of the water in a vessel, or by the rising of a float in a second vessel into which the first discharged; with the latter type, the float was connected to a dial for indicating the time.

Clever.—Possessing quickness of skill, dexterity, talent, or adroitness; expert.

Clevis.—A shackle; a piece of iron bent into a U shape, and perforated at the extremities for a pin.

Clew.—1. In navigation, one of the lower corners of a sail; to truss up sails to the yards.

2. To coil into a ball; to guide or track by a *clew*.

Clew Line.—In navigation, a rope made fast to the corner of a sail to clew it up to the yards.

Cliché Casting.—In founding, a mode of obtaining an impression from a die or wood cut, or the like, by striking it suddenly upon metal which has been fused and is just becoming solid; also the casting so obtained.

Click.—1. A short, sharp, non-ringing sound, commonly the result of an impact.

2. A *pawl* or detent working in a ratchet wheel.

Click Wheel.—In machinery, a wheel whose cogs are radial on one face and inclined on the other, so as to give a square face to the end of the *click*, pawl, ratchet, or detent, which prevents the back movement of the wheel. A *ratchet wheel*.

Climax.—Upward movement, steady increase; gradation; ascent; the highest point; the greatest degree.

Clinch.—A fastening in which the long end of a nail is turned over and the recurved end made to enter the material in such a way as to oppose being drawn out.

Clinch Bolt.—One whose pointed end is clinched after passing through the wood; sometimes over a washer or ring.

Clincher.—A tool for clinching; that is, turning over the pointed end of a nail so as to prevent its retraction. In wood, the end of the nail is bowed or turned over and driven into the piece through which it last passed. In horseshoeing, the end of the horseshoe nail is nipped off and the *stub* battered down, so as to oppose a hooked, flattened portion, against the action of a withdrawal.

Clincher Tire.—A form of pneumatic tire. The rim of the wheel has a turned-in edge on each side, forming a bead; into this fits a wired edge on either side of the tire, and the air pressure within the latter locks all together.

Clincher Work.—1. Lap jointed work. A mode of building in which the lower edge of each plank overlaps the one next below it, like the weather-boarding of a house; the shingles or slates of a roof.

2. In boat building, clincher work is used on boats of a lighter description, the galley, gig, cutter, jolly boat, etc. The lower edge of each strake of plank overlaps the upper edge of the next strake below. Also called *clinker built*.

3. In shipbuilding, a mode of uniting the iron plates of vessels, tanks, or boilers, in which the edges are lapped, and secured by one row of rivets. It is distinguished from *carvel build* in the respect that in the latter the edges of the

plates are brought together and the joint covered by an interior lap or *well*, to which the plates are secured by two rows of rivets, one to each plate.

Click.—To cause to give out a slight, sharp, tinkling sound, as by striking metallic or other sonorous bodies together.

Clinker.—1. A compact mass formed by combustion or by partial fusion of certain mineral substances, especially in the manufacture of *Portland cement*. In this an incorporated mixture of lime and clay is burned at a glowing heat, the resultant *clinker* being subsequently ground to the required fineness of powder.

2. A heavy vitrified slag, formed in burning certain coals, which clings to the bars of the furnace and clogs its air supply.

Clinker Brick.—A small hard brick used for paving, whose surface has been vitrified by the extreme heat of the kiln.

Clinker Cooler.—A device for utilizing the heat stored in the burnt clinker of *Portland cement*; the heated clinker, leaving the rotary kilns, is passed through a rotary cooler in which it travels in the contrary direction to the air, thus being cooled to the necessary point, and giving up its heat to the air supply for the kilns with consequent economy of fuel.

Clinker Hook.—A hooked fire iron employed by smiths to rake clinker out of the forge bed.

Clinometer.—A portable surveying instrument having a spirit level and a circular scale of degrees for reading the angle of strata, etc., with the horizon.

Clipper.—A fast sailing merchant ship, with fine lines, and a large spread of canvas. The name is derived from the speed or *clip* of the ship, just as the term *schooner* originated from *soon* or *schoon*, to skim the water.

Clip Pulley.—A type of pulley used in connection with wire rope haulage. The rim is composed of a number of hinged clips with V-edges, instead of the usual rigid sides. The strain of the rope tends to pull the clips towards each other, thus securing a better grip with a load.

Clips.—In piping, curved pieces of metal furnished with lugs; they may be either slight brass castings or else formed from strips of brass or sheet iron. Their chief use is in connection with piping, to afford a means of embracing it so as to stop a leak.

Clock.—An instrument or machine automatically recording the pulsations of a pendulum and consequently measuring time by the movements of hands over a dial graduated to the hours and their sub-divisions, also by striking the hours on a bell or chimes. The motive power is obtained from the descent of a raised weight which drives a train of wheels moving at different velocities to record the various intervals of time. The tendency to acceleration on the part of the train is periodically checked by an *escapement*, which checks the advance of the wheels at regular intervals; the pressure of the gearing is transmitted to the *pendulum*, and gives to the latter sufficient force to overcome the resistances tending to bring it to rest. A pendulum is unsuitable for a portable time piece and is replaced by a *balance wheel* and spring, while a driving spring is substituted for the falling weight.

Clock Spring.—A coiled spring, in the going barrel or the *striking barrel* of a clock, which runs it or strikes the hours.

Clockwise.—Said of machinery, when it runs right handed or as the *hands of a clock*, from left over to right. The reverse motion is termed *counter clockwise*.

Clod Crusher.—An implement used as a roller to break up the land after plowing, in which numerous circular cast-iron sections about thirty inches diameter are threaded upon a round axle.

Clog.—1. That which hinders or impedes motion, hence an encumbrance, restraint, or impediment.

2. A shoe or sandal intended to protect the feet from wet, and having therefore a thick sole. Greatly used in silk dye houses and sugar refineries.

Cloisonné.—A class of mosaic enamel work, in which the enamel is disposed in walled-off compartments. A ribbon of gold or silver is cemented edgewise on a copper background, so as to form the outlines of the pattern; the little cells or compartments so formed are filled with the enamel paste and the whole fired. This vitrifies it, and the piece is laboriously ground down to a smooth and polished surface, usually by means of sand and water.

Cloister.—In architecture, the covered way connecting a cathedral or monastery building with the refectory, chapter-house, or with the various subsidiary buildings. The cloisters are usually arranged around three sides of a quadrangle known as the *garth*, the fourth side being occupied by the wall of the principal building, usually the south side of the nave.

Close.—To stop, or fill up; as, an opening; to shut; as, to close the eyes, to close a

door; to bring together the parts of; to consolidate; to come or gather around; to enclose.

Closed Stokehole.—The usual method of applying *forced draught* to the furnaces of a steamship. The boiler-room is made into an air-tight compartment, entrance into which is obtained through *air-locks*. Into this compartment the air for combustion is forced under a plenum by means of fans.

Close Grained.—1. Iron is close grained when its crystals are of moderate size and densely packed. The term is, however, relative, since all heavy castings which are not cast under pressure are somewhat open and porous in their central portions. It is customary in specifications to stipulate for close-grained iron for special classes of work, as for example, engine cylinders and bright working parts.

2. Timber is close-grained when of slow growth, as evidenced by the small size of the annual rings.

Close Link Chain.—In blacksmithing, link chain, the length of whose links does not exceed five times the diameter of the iron of which it is made. Its width is three and a half diameters. Called close link to distinguish it from *circular link chain*.

Close Mouth.—In machinery, applied to punching bears and punching machines which are open, back and front, for the passage of bars but closed at the sides. Used for rails and bars. The term is used in opposition to *open mouth*.

Closer.—In building, a brick cut in half *lengthwise* to close an opening in a course. A *queen closer* is a closer brick cut in two transversely; a *king closer* is wedge shaped, being the full size at one end and beveled on one edge to a width of two and a quarter inches at the other.

Closet.—1. A small room or apartment for retirement; a room for privacy.

2. A small apartment, or recess in the side of a room for household utensils, clothing, etc.

Closing Hammer.—A hammer used by boiler makers and iron and steel ship builders, for closing the seams of iron and steel plates.

Closing Up.—1. In iron work, the riveting or burring over a rivet head, either by hand or by hydraulic pressure. The length of rivet required for closing up in hand riveting is $1\frac{1}{4}$ times the diameter, for snap head and conical rivets.

2. In a foundry, covering up or placing on of the top box or cope of a mould in readiness for casting.

Cloth.—1. A fabric woven from fibers of animal or vegetable origin, and used as a garment or covering.

2. Any substance woven so as to have the appearance of cloth, as *wire cloth*, *asbestos cloth*, etc.

Clothes Horse.—A form of dryer which stands on legs, and has cross bars on which textile articles or fabrics may be suspended to dry.

Clothes Pin.—Small spring nippers which pinch a fabric against the line from which it is suspended to dry. It may be a split pin or a pair of hinged fingers with a spring inclosed.

Clothes Wringer.—A frame having a pair of elastic rollers, through which fabrics are passed to squeeze out the water.

Clothing.—1. In steam engineering, a covering of felt or other non-conducting material put on the outside of a boiler or steam chamber to prevent radiation of heat.

2. In carding machines, bands of leather, studded with teeth of wire, which engage the fiber.

Cloth Wheel.—1. A grinding or polishing wheel, covered with cloth charged with an abrading or polishing material; as, pumice stone, chalk, rotten stone, crocus, putty powder, etc. The cloth is heavy, similar to that used for the blankets of printing presses. Felted cloths are sometimes used.

2. A form of feed movement in sewing-machines. A serrated-faced wheel protrudes upwardly through the cloth plate, and has an intermittent motion.

Cloud.—1. A collection of visible vapor or watery particles suspended in the upper atmosphere.

2. A mass or volume of smoke or flying dust resembling vapor.

3. A dark vein or spot on a lighter material; as in marble, hence, a *blemish* or *defect*.

Clough.—1. A gorge or ravine; an earthen vessel.

2. In civil engineering, a sluice used in returning water to a channel after depositing its sediment on the flooded land.

Clout Nail.—A strong wrought nail with a large flat circular head; used for securing leather and the like to wood, as in bellows, hand pump buckets, etc.

Clove Hitch.—In erecting, a noose or double loop for making fast a rope to a spar or another standing rope.

Clove Hook.—In navigation, an iron, two part hook, the jaws overlapping; used in bending chain sheets to the clews of sails, etc.

Clover Huller.—A machine designed to separate the seeds from the hull of the clover after having removed the heads from the straw by means of a threshing cylinder.

Clubbing.—In navigation, drifting down a current with an anchor out.

Club Bit.—In well boring, a drill bit with fluted sides, used in drilling artesian wells. The regular bits for a cable rig are all *club bits*.

Club Compasses.—A pair of compasses with a bullet or *cone* on one leg to set in a hole.

Club Hammer.—In building, a short handled heavy hammer used by bricklayers in shaping bricks.

Clump Block.—In navigation, one made thicker and stronger than ordinary blocks.

Clumsy.—Without skill or grace; wanting dexterity, nimbleness; stiff; unhandy; illmade; misshapen.

Cluster.—1. A number of things that are arranged close together, so as to form a *group*; an assembly or aggregation; as, a *cluster* of stars.

2. A number of things of the same kind joined, or collected together so as to form a *bundle*.

Clustered Column.—In architecture, a column which is composed, or appears to be composed, of several columns collected together.

Cluster Piles.—A group of piles, driven generally in a circle at the outer corners of a pier, to protect the pier during the landing, or so called *docking*, of steamers.

Clutch.—A mechanical device for engaging or disconnecting two pieces of shafting in the same line, or a shaft and a wheel, so that they revolve together or are free, at will. Two broad classes are used, one with positive connections by means of projections which engage with suitable recesses called the *jaw* or *claw clutch*; the second is the *friction clutch*, operated by means of cones, constricting pieces, or expanding shoes.

Clutch Band.—A ring, fitting into a groove on the sliding portion of a *jaw*

clutch, affording attachment to the lever which throws it in or out of gear. Also termed *clutch ring*.

Clutch Leather.—The leather lining applied to the male or female cones of *friction clutches*, to provide a higher friction than that of metallic surfaces.

Clutch Lever.—In automobiles, etc., the lever which actuates a clutch, throwing it into or out of gear, as desired.

Clutch Spring.—A spring arranged either to throw a clutch into gear or else to retain it out of gear; in the former case, the clutch lever must be locked to keep the clutch disengaged, in the latter it cannot be put into gear except intentionally. Usually fitted to *motor cars*.

Co.—1. An abbreviation of the word *company*.

2. In geometry and trigonometry, a contraction of the word *complement*.

3. A form of the prefix *con*; signifying *with, together, in conjunction, joint*.

C/o.—Abbreviation for *Care of*.

Coach.—1. In railway engineering, a passenger car distinguished from the cars for special purposes as *sleeping, dining, smoking car*, etc.

2. A large, closed, four-wheeled carriage, having doors in the sides and generally a front and back seat inside, each for two persons, and an elevated outside seat in front for the driver.

Coach Screw.—A large wood screw, with a square or hexagon head for turning by a wrench; as used in coach building and carpentry. Also known as *lag screw*.

Coagulate.—To change or cause to change a liquid into a curd like mass, either by heat, cold or the addition of a reagent.

Coak.—In building, a large dowel or pin used to connect two planks together; the square metallic bushing in the cheeks of a wooden block through which the pin is fixed.

Coal.—Vegetable matter compressed and mineralized so that it occurs in stratified fossil deposits. Chemical changes have reduced the oxygen originally contained, consequently increasing the percentage of carbon. The traces of the original vegetable structure are very few. Coals are classified as follows: 1, *Anthracite*; 2, *semi bituminous*; 3, *bituminous*; 4, *long flaming or cannel*; 5, *lignite or brown coal*.

Coal Breaker.—An apparatus with toothed rollers used to break the masses of coal into convenient pieces for the market, and sort them through screens or riddles. In the Pennsylvania *anthracite* region the sizes of coal are:—

Lump.....	will not pass mesh of 4	Inches.
Steamboat...	" " " 3	"
Broken.....	" " " 2½ to 2½	"
Egg.....	" " " 2½	"
Large Stove..	" " " 1½	"
Small Stove..	" " " 1½ to 1½	"
Chestnut....	" " " 1 to 1	"
Pea.....	" " " 1 to 1	"
Buckwheat..	" " " 1 to 1	"
Rice.....	" " " 1	"

The household sizes are egg and stove.

Coal Bunkers.—Compartments for storage of coal fuel. On shipboard, their dimensions and shape depend entirely upon the size and class of vessel, and the nature of the service. Ashore they are usually *bins* of moderate size, with conical bottoms so as to be self trimming, and are generally placed above the firing platform. In such case, an *elevator* or a *wagon hoist* is fitted, unless an elevated track for coal cars is erected over the bunker tops.

Coal Car.—A railway vehicle specially adapted for conveying coal, it is generally of the open or *gondola* type, and is further named from the manner in which it discharges its contents, as *hopper bottom car, end tip car*, etc.

Coal Chutes.—In labor saving machinery, a device made of wood or structural steel to load coal from elevated bins or bunkers into cars, ships or carts, and also to shoot it into the bunker of a boiler self feeder or to the tenders of locomotive boilers.

Coal Cutter.—In mining, a machine for hewing or undercutting coal, working with percussive blows or by a traveling serrated cutter, chain like or fixed on a wheel or arm. It is driven by electricity or compressed air.

Coal Dumping Apparatus.—An arrangement of lifts and dumps for loading vessels with coal directly from a car; as, a 50-ton car is dumped in five minutes, including *placing, dumping* and *moving away*.

Coal Dust.—In moulding, is used as an ingredient of foundry sand, or as *blackening, or facing* for the mould.

Coal Fields.—Districts or regions underlain by beds of coal.

Coal Gas.—A complex hydrocarbon gas, containing about 90 per cent. of hydrogen and marsh gas, and 5 per cent. of heavy carburetted hydrogen and acetylene. It is produced from the destructive distillation of coal, heated out of contact with air, in iron or fire clay *retorts*. The products of distillation are first cooled in *condensers* to free them of suspended coal tar and ammoniacal liquor; are then passed through *scrubbers*, or towers filled with wet coke, to dissolve out the ammonia; next through *purifiers*, in which trays of slaked lime or ferric oxyhydrate absorb sulphur and carbon dioxide from the gas; finally being stored in a *gasometer*, preparatory to distribution as an illuminant.

Coal Hod.—A box or *scuttle*, for holding coal for present use. They generally hold 30 to 35 pounds of coal.

Coaling Port.—Openings in a vessel's side, fitted with water tight doors. They serve as means for passing coal to the bunkers, thus avoiding dust and dirt on deck.

Coal Oil.—A colloquial expression in certain districts for *petroleum*, and also for the illuminating oils derived therefrom.

Coal Passer.—A man whose duties are, to trim or pass the coal from the bunkers to the stokehole, and to assist the firemen. Also called a *trimmer*.

Coal Screen.—A sifter for coal, at the mines. It is a very large cylinder with an inclined axis and portions of varying meshes, so as to sort the broken coal into sizes. In the coal pockets for shipping and retailing, the screens are stationary on the pocket and are generally made of angle and sheet iron frames with wire or perforated sheet iron screens.

Coal Scuttle.—A utensil for holding coal. Also called *coal hod*.

Coal Skips.—Large iron buckets, somewhat similar to either the *kibbles* or *corves* used in mining, and which are employed in gas works to transport coal, coke, etc., from place to place.

Coal Stage.—In railway working, the platform at a round-house, where locomotives are coaled. Also called *coal chutes*.

Coal Tar.—Condensed during gas manufacture from bituminous coal, in the form of a thick black liquid. In the hands of the modern chemist it is the source of many by-products; such as brilliant *aniline dyes*; *carbolic acid*; medicines as *antipyrine*; *saccharin* for sweetening; *creosote* for preserving wood, etc.

Coal Washer.—An arrangement subsidiary to the *coal breaker*, for washing and cleaning the coal to free it from dust.

Coal Winning.—The act of sinking shafts, levels and passages to attain the coal seams; the hewing and bringing to bank are termed *getting*.

Coaming.—A raised border around *hatches*, doorways and other openings aboard ship.

Coarse Stuff.—In plastering, the first coat of inside plaster work. It is composed of common lime mortar, as made for brick masonry, with a small quantity of hair, or by volume, *lime* 1 part, *sand* 3 parts, *hair* $\frac{1}{4}$ part.

Coast.—1. The seashore or land near it.
2. The exterior line, limit, or border of a country; frontier border.

Coaster.—A vessel employed in trading voyages from port to port, along a given coast.

Coat.—1. In navigation, a piece of tarred canvas put about the masts at the partners, the rudder casing, and also around the pumps, where they go through the upper deck, in order to prevent water passing down.
2. In building construction, a layer of plaster, paint, or whitewash.
3. In metallurgy, coating metals with metal as in plating, galvanizing, silvering, etc.

Coating.—In metallurgy, the process of covering metals with a superior metal as gilding, plating, silvering, galvanizing, platinizing, etc.

Cob.—1. In civil engineering, a type of stone breakwater.

2. In mining, to break ore with a hammer to reduce its size, to enable its separation from portions of the gangue, and its assortment into grades.

3. An unburnt brick, which has otherwise gone through the whole process of brickmaking.

Cobalt.—In chemistry, a tough, lustrous, reddish white metal of the iron group, not easily fusible and somewhat magnetic. It occurs in nature in combination with arsenic, sulphur and oxygen, and is obtained from its ores, *smaltite*, *cobalite*, etc.

Cobbing.—1. In mining and metallurgy, breaking the ore and separating the richer parts by hand.

2. Old brickwork; lining of furnaces containing copper, etc., used as a flux in refining.

Cobble.—1. A cobble stone, also called niggerhead, a rounded ball like stone with smooth face, generally of a dark color, and of a hard granite nature. In the early history of street paving, this stone was selected for that work and hence paving stones of all kinds go by the name of *cobble stone*; and the act of paving has been known as *cobble*.

2. To make clumsily.

Cobbler.—1. A clumsy workman.

2. One who mends shoes.

Coble.—A flat floored fishing boat with a lug sail, and a drop rudder extending from two to four feet below the keel. It is generally used for coast fishing where there are so called *short seas*.

Cob Wall.—A wall built up solid of a compost of puddled clay and straw, or of straw, lime and earth; also called *dobie wall* or *dobie work*.

Cochineal.—A rich crimson pigment obtained from the dried bodies of the wingless females of a variety of scale insect or plant lice, infesting a Mexican cactus. The coloring matter is extracted by treating the insects' bodies with boiling water containing a small quantity of alum or cream of tartar.

Cock.—In mechanics, a device for regulating the flow of fluids through a pipe, usually consisting of a tapered conical plug having a hole or port in it, and working in a shell of iron or brass bored out to receive the plug, and provided with passages to connect with pipes, etc., at either end. Rotation of the plug controls the passage of fluids by bringing the openings in the plug opposite those in the shell, or away from them. The particular use or construction of any cock is generally shown by its name, as *blowdown cock*, *angle cock*, etc.

Cockeye.—In millstones, a socket or recess in the underside of the bail or crossbar which straddles the opening in the upper or running stone; the *cock-head* or point of the spindle fits in the cock eye, these two parts bearing the whole weight of the running millstone.

Cockhead.—In milling, the upper point of a spindle which supports the upper millstone.

Cocking.—In carpentry, a mode of fixing the end of a tie beam or floor joist to a beam, girder or wall plate.

Cockle Cylinder.—In milling, a machine for separating cockle or tares, and other foreign seeds from wheat. The cylinder consists of a slowly revolving drum, the inner surface of which consists of a zinc plate drilled

with a great number of peculiarly shaped indentations, often as many as 2800 to the square foot. As the cylinder revolves, the cockle and small foreign seeds are collected by these indentations, while the wheat grains pass out at the end and are ready for milling. The seeds gathered in the pits or indentations are carried around by the cylinder until they reach a certain point, when they fall off into a conveyor, suspended in the lower half of the cylinder, which carries them away.

Cockpit.—The well in a half decked craft, the undecked portion of a small vessel or yacht.

Cocoanut.—The fruit of a tropical palm, used for many purposes; as, the hairy covering of the shell is utilized for making matting and ropes. The dried flesh of the nut is *copra*, whence is extracted a valuable oil used in the manufacture of soaps and candles, and in most tropical countries as an article of food and an illuminant. From incisions in the stem, is drawn the sap, which is fermented into *toddy*, used as an intoxicant or as yeast; unfermented sap is crystallized into *jaggery*, resembling maple sugar, which also makes a hard marble-like cement when mixed with burnt shells and white of egg.

C. O. D.—An abbreviation for *Cash on Delivery*. When a package is thus marked, it signifies that its value is to be collected from the consignee before delivery, either by the messenger, or by the express company which has undertaken to act as agent for the one who sent it.

Code.—A system or arbitrary arrangement of signals for effecting communications at a distance. The codification may simply be for the sake of brevity, or as a means of secrecy, the latter constituting a *cipher code*. Specific examples are:

1. Signal Flags, the representation of short phrases, names, common words, syllables or letters by means of arrangements of different colored flags or single flags. This constitutes the *Universal Maritime Code*, which bears the same meaning in all languages. For naval use, each navy has its private code, wherein flags denote numerals, and the combinations of numerals correspond to words, phrases, or orders, arranged in series in a book.

2. Dot and Dash; alphabetic signaling, similar to that of Morse used in telegraphy, whereby signals are made over long distances, by waving of small flags, by colored lights, heliograph or similar means.

3. Telegraphic; a system of words, a maximum of ten letters being permitted, which represents other words, phrases, or numbers, to secure brevity and secrecy. As an instance, by using words as numbers, a code message of 141 ten letter words has been expanded to 70 pages of typewritten foolscap.

Codling.—In cooperage, a balk sawed into lengths for staves. It is cleft or rived into staves by means of a frow and mallet.

Cod Liver Oil.—An oil obtained from the liver of the codfish, and used extensively in medicine as a means of supplying the body with fat in cases of malnutrition; also used in curing chamois skins, in currying, or in dressing and preparing various leather goods.

Coefficient.—In mathematics, a number or letter affixed to a quantity, to show how many times the quantity is to be taken. Hence a coefficient is a multiplier or factor, and when it enters into a formula, represents some known value, usually found by experiment.

Coefficient of Friction.—In physics, a factor or multiplier, depending upon the nature and condition of the surfaces in contact, and on their lubrication. The product of the *load* into the *coefficient of friction* gives the actual resistance due to friction.

Coffee Huller.—A machine to remove the husk or sac which covers the coffee grains. It consists of an arrangement of serrated surfaces on a belt, between which the envelope of the coffee berry is torn and loosened from the grain. Subsequent *rubbing*, *brushing*, *dusting* and *winnowing* complete the process of hulling the grain.

Coffee Polisher.—A machine for removing traces of mildew and stain from coffee as imported, or the effects of damp or heating in store. The coffee is discharged from the hopper upon a rim of a cylinder covered with elastic material and carried between the rubber and knobbed belt.

Coffer.—1. In architecture, a sunken panel in a ceiling, deeply recessed by one or more separate faces, having the appearance of inverted steps, and enriched with moldings in the several internal angles.

2. In hydraulic engineering, a *canal lock chamber*.

3. In shipbuilding, a large wooden vessel with movable ends to receive a barge or other vessel; a floating dock.

4. In tin mining, the box or mortar in which the ore is pulverized by the stamp.

5. A store chest for valuables.

Coffer-dam.—1. In civil engineering, a double wall of sheet piling between which is placed puddled clay; used to keep water out of excavations, as in docks, etc. Also a narrow excavation protected with sheet piling on each side to exclude water.

2. In ship building, a space two to four frames long between two oil tight bulkheads, used to insulate oil cargoes from machinery space or accommodation; sometimes the space is filled with water.

Coffering.—In mining, lining a shaft with masonry instead of *tubbing*. The

stones are shaped like the *voussoirs* of an arch and are built up in circular courses.

Coffer-work.—In masonry, *rubble-work*, faced with stone.

Cog.—1. In mechanics, a tooth in a gear wheel; more especially an inserted or mortise tooth.

2. In carpentry, the projecting central portion of a *cogged* or *bridge joint*. This consists of a rectangular mortise on either side of the upper surface of a beam, the central unremoved portion or *cog* remaining flush with the face. The cog receives and locks a transverse groove or notch in the under surface of the beam or joist which fits into the joint.

3. Anything inserted to check or prevent motion as a stone wedge or *skid* placed under the wheels of a vehicle to prevent backward movement down hill. Also, a rough stone pillar to support the roof of a mine working.

Cogging.—1. The act of fitting, inserting or applying a *cog* in any sense.

2. The conversion of *steel ingots* into *blooms* or the roughing down of piled masses of wrought iron into shapes suitable for finishing, by means of rolls.

Cogging Train.—In steel manufacture, the roughing train of rolls, which breaks down an ingot or billet approximately to the limits of the required section. Also termed *cogging mill*, *blooming mill*, etc.

Cog Wheel.—A spur or gear wheel with teeth around its circumference. In the early days of millwrighting, all teeth were formed of hard wood and inserted into the edges of discs, and the term has survived the general introduction of *solid wheels*.

Cohere.—1. To stick together; to cleave; to hold fast; as, parts of the same mass.

2. To be connected together in subordination to one principle or purpose; to follow naturally as the parts of a discourse, or as arguments in a train of reasoning.

3. To suit; to agree; to fit.

Cohesion.—In physics, the principle or property by which the particles of a substance hold together, opposed to *repulsion*. In *solids*, cohesion is greater than repulsion, especially in the case of metals; with *liquids*, the two forces are about balanced, while in *gases*, the force of repulsion is far greater than that of attraction.

Cohesive Attraction.—Attraction between ultimate particles, whether like or unlike, and causing simply an aggregation or union of these particles, as in the absorption of gases by charcoal. The power in adhesive attraction is strictly the same as that of *cohesion*.

Coil.—1. A series of rings or turns of wire, rope, etc. A spiral into which any thing is wound.

2. A number of turns of piping or series of connected pipes in rows or layers for the purpose of radiating or absorbing heat, as in *heating, refrigerating or condensing apparatus*.

Coil Clutch.—A very substantial form of striking clutch, in which shocks are taken up by stout coiled springs. It is designed especially for rolling mills, that the rolls may be reversed without stopping or reversing the engine, and is applied to heavy rail mills.

Coil Vaporizer.—A device for producing vapor from a volatile liquid by passing the latter through a coil, heated externally by a flame, etc. Used in certain types of lamps burning naphtha and the like, and in *petroleum engines*.

Coin.—A piece of metal on which certain characters are stamped by authority, giving the piece a legal current value.

Coincide.—1. To occupy the same place in space; as, two equal triangles, when placed one on the other.

2. To occur at the same time; to be of the same mind.

3. To correspond exactly; to agree; to concur.

Coining.—The act or art of stamping or impressing devices, inscriptions, the head of a ruler or some symbolical figure or figures upon flat circular blanks of *gold, silver*, or other metals, thereby converting them into money. The operation is carried out under legal authority in duly authorized mints, and the coins put into circulation through proper channels, to make it *legal tender*.

Coin Meter.—An adaptation of the automatic vending machine to the supply of illuminating gas or electricity. Upon placing a coin, such as a shilling or a quarter dollar, in the slot, the meter supplies so many cubic feet of gas or kilowatt hours of electric energy, according to the scale of prices.

Coir.—A fiber, woven from the husk of the *cocoanut*.

Coke.—The result of the distillation of coal. It is carbonized in heaps, in ovens, or in the retorts of the gas houses, the bulk of the mass is increased by coking, the weight diminished from 80 to 55 per cent. according to the mode of conducting the process. It is used for fuel in manufacturing and household purposes, also for filtering purposes. In many gas works the coke from the coal gas is utilized in the manufacture of *water gas*.

Coke Bed.—In founding, a layer of coke or cinders placed at the bottom of a large mould which is prepared on the shop floor, to permit easy escape of the gases from the lower portions of the mould. Also, the layer of coke placed at the bottom of a *cupola* before charging.

Coke Fork.—A large digging fork used for handling coke in iron foundries and the like; it has a short spade handle and is furnished with ten or twelve tines.

Coke Oven.—A retort furnace in which coal is subjected to external heat, distilling off the volatile hydrocarbons, removing arsenic, phosphorus, and as much sulphur as possible, leaving the carbon as residue. The gases are led away and condensed, giving as byproducts, tar and ammoniacal liquor, together with a coke yield of 70 to 80 per cent. of the coal distilled.

Coke Plate.—In metals, tin plate for which the sheet iron has been refined with coke, as distinguished from *charcoal plate*. Coke plate now commonly refers to plate made from puddled iron. This is inferior in quality to charcoal plate.

Colander.—A strainer formed of perforated sheet metal. The colander for pouring lead in the making of shot is a hollow hemisphere of sheet iron, about 10 inches in diameter and perforated with holes which are free from burrs.

Colburn, Zerah.—Born 1804, died 1840. A mathematical prodigy. The son of an illiterate Vermont farmer, he developed at the age of six an amazing aptitude for mental calculation. His talent proved so remarkable, that he was exhibited by his father in the chief cities of the U. S. and afterwards in England and France, everywhere attracting great notice. Such difficult questions as "How many minutes are there in 1811 years"? "What is the square of 1449"? were correctly answered by the child in a few seconds by mental processes which he himself could not comprehend. At the age of nine he performed the almost incredible feat of naming almost outright the only two factors of 4,294,967,297. When sent to school, however, the boy showed no special capability, not even in arithmetic, and as he grew older his peculiar powers failed him; so that when he died, he had gained no personal advantage from his gift, and had contributed nothing to the sum of human knowledge.

Cold.—A colloquial expression for the opposite of heat; when exposed to a temperature below the average, the sensations experienced, to which the name of *cold* is given. Properly speaking, there can be no such thing as cold—only a greater or less degree of heat, at any point above that of absolute zero.

Cold Air Process.—A system of refrigeration. Atmospheric air is compressed by steam power, its latent heat becoming sensible under compression; this heat is carried away by the cooling water of a surface condenser, so that when the air is expanded, in the larger or expansion cylinder of the refrigerating machine, it has to draw the necessary heat for the process of expansion from an external source, which is arranged to be the air of the refrigerating chamber into which the discharge from the expansion cylinder takes place. The compression cylinder draws its supply of air from this same refrigerating chamber, and thus the cycle continues.

Cold Blast.—In metal working, air forced into a smelting furnace at a natural temperature, in contradistinction to a heated blast, which is more economical, but is thought to produce an inferior quality of iron.

Cold Blast Iron.—A very tough, strong brand of pig iron, made, as the name implies, without heating the blast. This iron is used to reinforce special mixtures where a hard surface is required, as for cylinder barrels, valve faces, etc.

Cold Chisel.—A tool of hard, strong steel, tapering to one end which terminates in a beveled point, which is tempered so that the chisel can cut metal when struck a blow with a hammer or mallet on the other end, but is not so hard that it breaks under the blows. A chisel should be tempered from a brownish yellow to a light purple (500° to 630° F.). The sides of a *chipping chisel* should slope at 22° to 25°, the cutting bevels at 80°; a *bolt cropping chisel* should have an angle of 30° between the sides and 75° at the point. Oval steel is recommended for the former and hexagon for the latter, to secure an easier grip and also serve to distinguish one tool from the other.

Cold Drawn.—A term applied principally to such oils as *castor*, whose better qualities are expressed without preliminary heating of the seeds or nuts. Also used in connection with wire or seamless tubes, which are drawn to size through rolls or dies while *cold*.

Cold Rolled Shafting.—Round shafting rolled to exact size while cold; the passage through the finishing rolls produces a smooth polished surface resembling the effect of planishing on sheet metals. Turning is unnecessary on these bars, and the unbroken "skin" renders it very strong.

Cold Rolling.—In rolling mills, the practice of rolling iron plates and shafting cold produces a material having a high tensile strength but with a corresponding sacrifice of ductility and toughness. Its effect is,

therefore, the reverse of annealing. The surface of iron when cold rolled acquires a greater smoothness and polish than when rolled hot.

Cold Saw.—A circular saw, thick in proportion to its diameter, used for cutting cold iron or steel. It runs at a slow speed, is generally lubricated by soapy water or oil, and has its teeth sharpened square across the disc.

Cold Set.—A blacksmith's tool for cutting unheated iron bars; it is a short thick chisel set at right angles to a rod or osier handle.

Cold Short.—A term applied to a metal, such as iron, when it cannot be worked under the hammer or by rolling, or be bent *when cold*, without cracking at the edges. Such a metal may be worked or bent when at a great heat, but not at any temperature which is lower than about that assigned to dull red. This defect is due to the presence of phosphorus, arsenic or silicon in the iron.

Cold Shut.—In foundry work, when, through cooling, the metal passing round the two sides of a mould does not properly unite at the point of meeting.

Cold Soldering.—A process of amalgamation of metallic surfaces by the aid of mercury. A hard amalgam is made of five or six parts of pure silver, three or four parts of tin and three to five per cent. of bismuth. This alloy is melted and cast into ingots, the ingots reduced to fine filings, and those filings mixed when required, with enough mercury to form a stiff paste, which hardens in about an hour.

Cold Storage.—1. The process or business of maintaining the interior of properly insulated buildings at a low temperature by means of mechanical refrigeration, so that meat, articles of food, and other perishable commodities may be preserved.

2. A building devoted to the business of cold storage.

Cold Water Test.—The ordinary test of boilers, cylinders, pipes, etc., by water at ordinary temperatures, as distinguished from a test in which warm water or steam is employed. Also called *hydraulic test*.

Collapse.—To fall together suddenly, as the sides of a hollow vessel; to close by falling or shrinking together; to have the sides or parts of a thing fall in, or be crushed in together; as a flue in a steam boiler sometimes *collapses*.

Collapsing Pressure.—In steam engineering, the pressure which, applied to the outside of a tube, causes it to fall by

bending or crumpling inwards. In its usual application, it has reference to the tubes and fire boxes of steam boilers.

Collapsing Tap.—In engineering, a machine tap used for making internal threads in fittings, etc., the pieces which carry the cutting teeth receding from the thread as soon as they reach the bottom of the hole, thus permitting the tap to be withdrawn without reversing its motion.

Collar.—1. In engineering, an enlarged cylindrical portion of a shaft, or a cylindrical ring or sleeve secured upon the shaft, in either case to serve as an abutment for securing something or preventing longitudinal movement of the shaft itself; as a *set collar*.

2. In mining, the timbering around the mouth of a shaft.

3. In civil engineering, the curb around the top of a shaft to restrain the friable superficial strata and to keep loose matter from falling in.

4. In navigation, an eye formed in a bight of a shroud or rope, to pass over a masthead, to hold a dead eye or a block, or for other analogous purposes.

5. In coining, a steel ring which confines a planchet and prevents lateral spreading under the pressure or blows of the coining press. When the edge of the coins are to be lettered, the letters are sunk in the collar, which is in three pieces, confined by an outer ring.

Collar Beam.—In carpentry, a tie beam uniting the breasts of a pair of rafters to keep them from sagging or spreading. It acts as a strut, a tie, and often as a ceiling joist for a garret story.

Collar Bearing.—A bearing provided with several rings or collars, to take the thrust of a shaft or in the case of a vertical shaft, to provide adequate surfaces for lubrication.

Collar Gauge.—A ring or internal gauge for testing the dimensions of external cylindrical pieces; the corresponding gauge for testing cylindrical holes is the *plug*.

Collar Tool.—In blacksmithing, a rounding tool for the formation of collars or flanges on rods by a process of swaging. It has a lower part which is set in the *hardy hole* in the anvil and an upper part called a *fullering tool*.

Collateral Security.—Security for the performance of covenants or the payment of money, besides the principal security.

Collect.—1. To gather into one body or place; to assemble or bring together; to obtain by gathering.

2. To demand and obtain payment for an indebtedness; as, to *collect taxes*.

Collecting Vessel.—In steam engineering, a cylindrical vessel enclosed in a steam boiler for the purpose of collecting the muddy ingredients contained in the water, which would otherwise produce scale and cause incrustation. The vessel is perforated to admit the water which bubbles over into it, carrying over also the sediment, the last settling down into the smooth water within the vessel, to be subsequently blown out at intervals.

Collector.—One who collects things which are separate; an officer whose duties are to collect and receive customs duties, taxes, etc.; one who is authorized to collect debts.

College.—1. A collection, body, or society of persons engaged in common pursuits, or having common duties and intents, and sometimes by charter, peculiar rights and privileges.

2. A society of scholars and friends of learning, incorporated for study or instruction, especially in the higher branches of knowledge.

3. A building or a number of buildings, used by a college.

Collet.—A small metal ring used for various purposes; as,

1. A ring, collar or flange secured upon an arbor or spindle.

2. The disc or ring which holds the dies in a screwing machine.

3. A small socket for holding a drill or bit.

4. The ring used to retain metallic packing in a stuffing box.

Collier.—1. In navigation, a vessel employed in the coal trade or one employed to supply warships with coal.

2. In mining, one engaged in digging coal or making charcoal.

Colliery.—1. The place where coal is dug; a coal mine, and the buildings, machinery, etc., belonging to it. It is generally understood to mean more than one mine operated by the same company, and located usually near together.

2. The coal trade.

Collision.—The act of colliding or forcibly coming together—especially of two vessels or two railroad trains.

Collision Mat.—A large mat, composed of canvas and sennet, carried upon ships etc., to be lowered over the side in case of collision or similar accident to prevent the entrance of water through the breach.

Collodion.—A solution of pyroxylin (soluble gun cotton) in ether containing a varying proportion of alcohol. It is strongly adhesive and is used by surgeons as a coating for wounds; but its chief application is as a vehicle for the sensitive film in photography.

Colloid.—In physics, a term applied to such jelly like substances as glue, gelatine and albumen. They are non-crystalline, and diffuse slowly through a membrane.

Colonnade.—In architecture, a range of columns, placed at regular intervals, and supporting an entablature.

Color.—A property, depending on the relations of light to the eye, by which one is capable of distinguishing individual and specific differences in the hues and tints of objects. The sensation of color is due to differences in the *wave lengths of light*, the portion of the rays which is not absorbed by a surface giving it its distinctive color.

Color Blindness.—Total or partial inability to distinguish certain colors or shades of colors. The defect may be either congenital or acquired, and is often found in eyes whose vision is otherwise perfect.

Color Doctor.—In calico printing, the contrivance that wipes an excess of color or mordant from the surface of the printing cylinders, leaving it in the engraved spaces only.

Coloring.—1. In electroplating, the employment of special salts in the dipping baths, intended to produce shades and tints of colors on the plated articles other than those due to simple metals as gold, silver, copper or nickel.

2. In currying leather, application of a mixture of oil, lamp black and tallow to the flesh side of the skin, blackening it for use in boot uppers.

Color Tempering.—The ordinary tool room method of tempering steel, in which, after hardening, the steel is reheated to draw the temper, which is indicated by colors forming on the piece, due to films of oxide of varying thickness. When the color appears, corresponding to the desired hardness, the steel is immediately plunged into the bath to quench it.

Colter.—A knife or sharp edged bar, usually secured to a beam and projecting downward in front of the breast of a plow. Its duty is to make the incision in the soil in advance of the share, making a vertical cut the width of the *furrow-slice* which is to be cut below by the share and turned over by the *mold board*.

Colt, Samuel.—Born 1814, died 1862. An American manufacturer and inventor. In 1835-6 he secured patents in the U. S. and Great Britain for a type of pistol provided with a rotary cylinder having several chambers to be discharged through a single barrel. It was not until 1848 however that his invention obtained general acceptance. At that time he erected a large plant in Hartford, Conn., where besides making his revolver, he constructed the machinery for its manufacture elsewhere. He also invented naval torpedoes, and was the first to lay a submarine cable (1845) which was successfully tested in New York harbor.

Column.—1. In architecture, a vertical support, very tall in proportion to its thickness. The column constitutes one of the chief divisions of each order of classical architecture, and is divided into three parts—*base, shaft and capital*—each ornamented in a distinctive manner.

2. In engineering, a vertical support subject to compressive stress. As the resistance of most materials to crushing is so great, failures are generally due to bending, hence the column is designed so as to avoid *flexure*.

3. An upright cylindrical body or structure, considered as resembling, in form or position, a column in architecture; as, a *column of air*, of water, of mercury, etc.

4. In railway vehicles, the casting which occupies the center of a diamond truck frame, connecting the top and bottom bars, and providing a guide for the *bolster*.

5. In calico printing, a device for fixing colors on the fabrics by the means of steam, consisting of a copper column around which the cloth is wrapped, steam issuing through numerous perforations in the cylinder and percolating through the fabric.

Column Bolt.—In machinery, a bolt which fastens or secures the machinery and at the same time serves also as a column.

Colza Oil.—A pale yellow oil expressed from the seeds of the rape plant, having a specific gravity of .912—.920 at 60° F. The oil is used as an illuminant and a lubricant; for the latter purpose it is *blown*, that is, has air blown through it while heating; the blown oil may be used alone or mixed with mineral oil. Ordinary colza is employed in making soft soaps and blacking; its residue of crushed seeds is made into *oil cake*.

Comb.—1. In manufacturing, a rake shaped implement consisting of a head with two or three rows of tapering steel teeth, the rows being of different lengths and used in combing long stapled wool.

2. In carding, the serrated *doffing knife* which removes the fleece from the *doffing cylinder* of a carding machine.

3. In machinery, a steel tool with teeth corresponding to those of a screw, and used for chasing screws on work which rotates on a lathe.

Combination.—1. The act or process of combining or uniting persons and things.

2. In mathematics, the different arrangements of a number of objects, as letters into *groups*.

Combination Car.—A railroad car containing two or more compartments used for more than one purpose; as, one carrying both passengers and freight.

Combination Gauge.—In steam engineering, a dial gauge which has two sets of registers; as, pressure and vacuum, pressure and heat of water, pressure and heat of steam.

Combination Lock.—A lock in which the mechanism is controlled by means of a movable dial (sometimes by several dials or rings) inscribed with letters or other characters. The bolt of the lock cannot be operated until the dial has been so turned as to combine the characters in a certain order.

Combined Carbon.—In chemistry, carbon which has entered into true chemical combination with iron to form white pig iron, steel, etc., and is not perceptible to the eye; as distinguished from the *graphitic carbon* that is mixed rather than combined, and which gives the gray appearance and comparative softness to cast iron.

Combing.—An operation in the worsted, or long wool manufacture. The straightening and disentangling of wool; corresponding in purpose with *carding of short wool*. In hand combing, the work is done between two combs; one held stationary and the other drawn over it, to comb out the lock of wool placed between them. The combs have a number of steel spikes fixed into a back, and are occasionally heated in a *comb pot*. In machine combing, the locks are fastened to two toothed cylinders which revolve in opposition to each other, and are heated by steam within; the teeth of one cylinder *comb* the fibers on the other.

Combining Weights.—In physics, the proportions in which elements or compound substances react upon each other; they are either the same as the atomic or molecular weights of the various substances, or a simple multiple or factor of those weights.

Combustible.—A substance that will take fire and burn.

Combustion.—The act or state of burning. Properly, a chemical union of substances, whose combination is sufficiently energetic to evolve heat and light. Thus the combustion of ordinary fuels is due to the rapid combination of the carbon contained in the coal, coke, or wood, with the oxygen of the atmosphere.

Combustion Chamber.—In boilers, a portion of the internal heating surface

arranged so as to afford space for better commingling of the furnace gases; for instance, in a flue and return tubular boiler, the hot gases pass from the furnace through large tubes or flues to the *combustion chamber* at the further end of the boiler, thence they return through small tubes to the uptake and funnel.

Come Down.—In steam engineering, boiler crowns are said to "come down" when the plates are bulged downward into the firebox through overheating, due generally to the accumulation of deposit thereon.

Coming to Nature.—In metallurgy, a term used by puddlers to denote the approach of the pasty stage in the iron within the furnace.

Command.—To order with authority; to direct; to bid; to charge; to have power or influence.

Commander.—1. In navigation, a large wooden mallet, used in sail and rigging lofts in driving the *splicing-*fd**.

2. In hat manufacture, a string on the outside of the conical hat-body, pressed upon it, down the sides of the block, to bring the body of the hat to the cylindrical form.

3. A chief; one who has supreme authority; a leader.

Commence.—To have a beginning or origin; to originate; to start; to begin.

Commerce.—Extended trade. The exchange of goods, productions or property of any kind; especially exchange on a large scale; as between countries.

Commercial Traveler.—An agent of a wholesale house who travels from town to town to solicit orders.

Comminute.—To reduce solids to minute particles by grinding or crushing.

Commission.—1. An allowance paid to an agent for transacting some commercial business; usually a percentage on the amount of value involved.

2. A body of two or more persons entrusted with the performance of certain special public or legal duties.

Committee.—One or more persons elected or appointed, to whom any matter or business is referred, either by a legislative body, by a court, or by a collective body of men acting together; as, a committee elected by a trades union to call upon the employers regarding wages, etc., before a strike is declared.

Commixture.—1. The act or process of mixing; the state of being mingled; the blending of ingredients in one mass or compound.

2. The mass formed by mingling different things; a compound; a mixture.

Commodious.—Adapted to a certain use or purpose, or to wants and necessities; serviceable; spacious and convenient; roomy and comfortable; as, a *commodious* house.

Commodore.—In navigation, an officer who ranks next above a captain, sometimes by courtesy, senior captain of a squadron. A title given by courtesy to a senior captain of a line of merchant vessels, and also to the chief officer of a yachting or rowing club.

Common.—Belonging or relating equally, or similarly, to more than one; often met with; frequent; customary.

Common Carrier.—One engaged in the transportation of persons and goods from place to place, doing such services for hire, for all persons indifferently. Railway, stage-coach and steamship companies are common carriers.

Common Fraction.—In mathematics, a number of equal parts of a unit expressed in terms of a numerator and denominator, as distinguished from a decimal fraction. Also known as a *vulgar fraction*.

Common Multiple.—In mathematics, a multiple of several quantities or numbers, which is exactly divisible by each of them, as 24 is a common multiple of 12, 8, 6, 4, 3 and 2.

Common Rafters.—In building, the lighter rafters which lie between the main rafters, and cross the purlins; as in a roof structure.

Common Slide Valve.—On a steam engine, a D shaped sliding piece located in the steam chest and controlling the distribution of steam to and from the cylinder, by moving back and forth over the *steam ports*, connecting them alternately with the boiler and exhaust passages.

Common Thread.—In machinery, an ordinary standard machine thread, as distinguished from a *pipe thread*.

Commotion.—1. Disturbed or violent motion; agitation.

2. A popular tumult; public disturbance; riot.

Communication Cord.—In railway working, a cord, running the whole length of each car, connecting with the *car signal valve on the signal pipe*. The signal valve is opened by pulling the cord, and the subsequent reduction of pressure in the signal pipe permits the air to escape to blow the signal whistle located in the locomotive cab.

Compact.—Joined or held together; confederated; closely or firmly united; as, the particles of solid bodies; firm; close, solid; dense; brief.

Companies' Risk.—A tariff of rates for merchandise under which the railway or other company is responsible for all damage, loss, or delay to the articles transported; the rate thus includes insurance as well as freight.

Companion.—One who accompanies or is in company with another for a longer or shorter period, either from choice or casually; one who is much in the company of, or is associated with, another or others; an associate; a partner.

Companion-way.—On shipboard, a stairway leading from the deck to a cabin.

Company.—An assemblage or association of persons either permanent or transient; guests or visitors, in distinction from the members of a family; partners in a firm whose names are not mentioned in its style or title.

Comparator.—An instrument used for making linear comparisons, or measurements. It consists of two microscopes sliding on a bar over a finely graduated scale.

Compass.—The *magnetic compass* consists of a magnetic needle pivoted on a fine point within a suitable case; below the needle is placed a card graduated to degrees and the cardinal points, so that the movements of the needle, which lies N. and S., always indicate the bearing of any object. The *mariner's compass* consists of a skeleton card mounted upon the needles, two or four parallel magnets being employed. There are two graduated circles, the inner showing the 32 points, halves and quarters, the outer graduated to 360°. The N. and S. diameter of the cards is parallel with the needles, the N. point being indicated by a *fleur-de-lis* ; a black line (the *tubber's line*) is drawn vertically on the case in line with the vessel's keel, so as to show the direction of her head. The compass is mounted on *gimbals*, to preserve its horizontal position, the whole being mounted upon a *binnacle* , containing provision for counteracting *deviation*. A *spirit compass* is filled with a mixture of 1 alcohol, 2 water, within which the card floats and is hermetically sealed.

Compass Calipers.—A machinist's tool for scribing work; one leg is straight as with a pair of compasses or dividers, the other curved like outside calipers. It is used for scribing lines parallel with the edge of work, and is frequently provided with a spring joint, being then set by a thumb screw. It differs from the ordinary *jenny-legs*, which have one leg straight and the other curved like inside calipers reversed. Both types are known as *hermaphrodite calipers*.

Compasses.—An instrument for describing circles, sub-dividing distances, etc., consisting of two, or rarely more, pointed branches, or legs, usually joined at the top by a rivet, on which they move.

Compass Needle.—The polarized bar which is suspended so as to assume a direction resulting from the earth's magnetism.

Compass Plane.—A plane whose sole or bottom is curved in the direction of its length, permitting it to be used in truing up concave surfaces.

Compass Saw.—A saw with a tapering blade, one inch wide at the handle, and a quarter inch at the point, which can be used for cutting out curved or circular work, its *kerf* allowing it to be operated slantingly. It is also termed a *key hole saw*, and is used by carpenters and plumbers wherever space is limited.

Compendium.—A brief compilation or composition, containing the principal heads, or general principles of a larger work or system; an abridgement; an epitome; a condensed summary.

Compensate.—To make suitable return for; to remunerate; to recompense; to give an equivalent to; as, to compensate a laborer for his work.

Compensated Pendulum.—A pendulum fitted with some form of device to counteract the difference in length caused by expansion. In one form, the *bob* is suspended by a framework of iron and brass rods, the upward expansion of the brass compensating the lower effect of the iron; in another, the bob or weight consists of a tube containing mercury, the upward elongation of the mercury counteracting the lengthening of the pendulum. In colder weather the downward movement of the brass or mercury balances the shortening of the rod.

Compensating Brake.—A braking device which is applied at two or more points, and so arranged that *equal pressure* shall be exerted simultaneously upon each point.

Compensating Carburetter.—An automatic attachment to a carburetter controlling either air or fuel admission, or both together, so that the due proportion of one to the other is always maintained, under variation of power required.

Compensating Collars.—In machinery, annular rings or collars inserted on the spindles of drilling machines between the feed screw and the grooved spindle, to form hard wearing surfaces, by whose adjustment, the wear of the spindle and collars can be taken up.

Compensating Cylinder.—An equalizing device, found on some high duty pumping engines, attached in pairs to each piston rod. It is an oscillating cylinder, closed at one end, within which works a plunger jointed to the main rod. On the pump starting from the end of its stroke the plungers are driven into the compensating cylinders, forcing the contained water or oil through the hollow trunnions into an accumulator or *intensifier*, the cylinder swinging on its trunnions as the stroke advances. When the pump has passed half stroke and steam is cut off by the valves, the compensating cylinders assist to drive the piston on its way, thus restoring the energy delivered into the accumulator at the beginning of the stroke. The whole serves as a reservoir of energy, comparable to a fly wheel.

Compensating Gear.—In motor cars, an arrangement of bevel wheel gearing which permits one wheel of an automobile to revolve faster than another in going around a curve. The same as *differential gear*.

Compensating Governor.—An attachment to a gas burner, or to the supply pipe of a building, whereby the quantity of gas passed is proportioned to the pressure in the main, thus ensuring equable consumption and economy in the quantity burned for a given light.

Compensating Ring.—A doubling plate or ring riveted around openings in a boiler shell to compensate for the metal cut away. Also known as *compensation ring*.

Compensation.—That which makes good the loss or want of something. In mechanics, that which creates a balance of forces, or acts as a counteractive of opposing tendencies.

Compensation Balance.—A balance wheel for a watch or chronometer, so constructed as to make even beats.

Competency.—Fitness; the state of possessing necessary qualifications to fulfill certain duties. In *engineer's certificates* it denotes knowledge tested by examination, as distinguished from that assumed to be possessed by virtue of long employment.

Complement.—1. Something that fills up or completes any number, quantity, word, or other thing which lacks completeness.

2. In geometry, the difference between a given angle and 90°.

3. In shipping, the entire crew or ship's company of officers and men, necessary, or assigned to any vessel.

Complete.—1. To bring to a state in which there is no deficiency; to perfect; as, to complete a course of education.

2. Finished; ended; concluded; completed; as the building is complete.

Complete Combustion.—In physics, combustion where all the elements contained in fuel, or in gaseous charges, enter fully into chemical combination with atmospheric air. In chemical language, their atoms are fully satisfied. The regulation of the fuel and air supply of furnaces should, for economical reasons, approximate as nearly as possible to these conditions.

Complex.—Composed of two or more parts; composite; not simple; involving many parts; complicated; intricate.

Comply.—To yield assent; to accord, agree, or acquiesce; to adapt one's self; to consent or conform.

Compo.—An abbreviation of composition, applied in various businesses, notably:

1. In building, a mortar made of cement and sand.

2. In plumbing, small gas pipe composed of an alloy with tin, etc., instead of pure lead.

Component.—1. In mechanics, one of the parts of a stress or strain, out of which the whole may be compounded by the principle of the parallelogram of forces.

2. A constituent part; as, the components of a rifle or bicycle.

Composition.—1. The act of composing, of forming a whole by placing together and uniting different things, parts or ingredients.

2. Anything so made up of different ingredients, as various alloys used by brass founders and others; the mixture of glue, molasses and the like boiled together to form rollers for printer's inks, cements, etc.

Composition of Forces.—In mechanics, the finding of a single force, called the *resultant*, which is equal to two or more given forces acting in given directions.

Compositor.—A printer who sets type, as distinguished from one who attends the press, etc.

Compound.—Composed of two or more elements or parts; produced by the union of several ingredients, parts or things.

Compound Air Pump.—One having compound cylinders either for air or steam or for both, to promote economy in steam consumption or to attain the same end by performing the operation of *compression in two stages*.

Compound Arithmetic.—The addition, subtraction, multiplication, division, etc., of compound numbers.

Compound Compression.—The operation of compressing air, ammonia or other gases in two stages, successive pressure being applied at each stage, the size of the compressor cylinders being correspondingly reduced. This gradual process overcomes much of the loss occasioned by super heating of the cylinders and facilitates the attainment of high pressure.

Compounded Gears.—In screw cutting, when the change wheels are arranged in a double train they are said to be compounded.

Compound Engine.—A steam engine in which the steam is expanded in two stages thus reducing the range of temperature in the cylinders, and making the turning effort more uniform. The cylinder of the first stage of expansion is termed a *high pressure cylinder*, the larger or second one the *low pressure*. Sometimes a compound engine has three cylinders, one *high pressure* exhausting into two *low pressure* cylinders. This type should not be confounded with a three cylinder *triple expansion* engine in which the steam passes from the high to the intermediate, thence to the low pressure cylinder.

Compound Fraction.—In arithmetic, a fraction of a fraction; two or more fractions connected by *of*, as $\frac{1}{2}$ of $\frac{1}{3}$.

Compound Gauge.—A pressure gauge registering pressures above and below that of the atmosphere, or *pressure* and *vacuum*. The needle points at 0 lbs. when the gauge is in equilibrium, the movement to one side showing the deficiency below atmospheric pressure (usually in inches of mercury), the motion to the other side indicating pressure above atmospheric (usually in lbs. per sq. in.). A compound gauge is often fitted to the low-pressure receivers of compound steam engines, or to the suction connections of pumps,

Compound Girders.—Those built up of other sections; thus a compound iron girder will be built up of I and channel beams with flat plates riveted thereto; a compound wooden girder is composed of two or more beams so placed that the compound beam has the *depth* of the assembled beams.

Compounding.—1. In engineering, combining a high pressure cylinder with a low pressure cylinder, thus forming a unit capable of working with higher steam pressure and a greater range of expansion.

2. In locomotive operation, manipulating the valves in such a manner that the steam, exhausting from one or more cylinders, passes into the low pressure cylinder or cylinders thus securing compound working. Most compound locomotives are arranged to work simple at pleasure, as at starting under heavy loads or in ascending steep gradients.

Compound Lever.—In mechanics, a system of levers by whose combination extra power is developed within a restricted space, the mechanical gain equalling the product of all the long arms divided by that of all the short arms.

Compound Locomotive.—A type of engine in which the cylinders are *compounded*; that is, having the steam expanded successively in two stages before exhausting.

Compound Microscope.—A microscope possessing a very high degree of magnifying power. It consists of a combination of two lenses, one of which, the *object glass*, forms an inverted image of the object; the other lens or *eye piece*, enlarges the image thus formed.

Compound Numbers.—In arithmetic, units of two or more denominations of the same kind, as 5 yards, 1 foot, 4 inches; 6 T., 8 cwt., 3 qrs.,—these are compound numbers; but *ten oxen*, or *five dollars*, are simple numbers.

Compound Oils.—In lubrication, the advantage of a compound oil is believed to consist in this, that certain advantages of single oils are gained and their disadvantages neutralized, thus, an *animal oil* alone is liable to develop acid, to the consequent corrosion of the bearings with which it is in contact; a *vegetable oil* alone is apt to dry and gum or become sticky and clog the bearing; a *mineral oil* alone is usually thin, has a low firing point and is liable to become squeezed out and evaporated. But by a combination of the three, the body of the animal oil is retained while its tendency to decomposition is lessened, the good lubricating property of the vegetable is utilized without much gumming taking place, and the flashing

point of the mineral is raised or counteracted, while its fluidity and its cleansing action are utilized.

Compound Rail.—In railways, a rail made of several portions with a longitudinal joint, avoiding the transverse joint *across* the rail whereby jarring is occasioned; a *continuous rail*. The term may also be applied to several forms of rails which consist of a number of portions bolted or keyed together.

Compound Rest.—Also called *compound slide rest*; a type of lathe rest in which auxiliary slides are superposed on the carriage for surfacing or traversing by hand in addition to the self acting motions.

Compound Screw.—Two or more screws on the same axis. When the pitch of the respective screws varies, it forms a *differential screw*; when they run in different directions, it is a *right and left screw*.

Comprehend.—To contain; to embrace; to include; to take into mind; to grasp with the understanding.

Compress.—To press together; to force, or drive into a narrower compass; to bring within narrow limits or space.

Compressed Air.—Atmospheric air compressed by mechanical means into a state of increased density. The air is often compressed by pumps at a central station whence it is led in pipes to the spot where the power is required. It may also be transported in steel tanks of convenient dimensions. The power stored in the air is given up on expansion within a cylinder, where it drives a piston in the same manner as steam. Compressed air is employed to drive drills, riveting and chipping machines; many varieties of portable tools; hoists and pumps; small scattered engines or auxiliary machines for various purposes. Compressed air is specially suitable for mines and tunnels, as there is no fire, smoke or steam, and the exhaust air improves the ventilation.

Compressed Air Lift.—A form of elevator in which air takes the place of water as a motive power, the cage being supported by an air cylinder. It is specially used for charging blast furnaces.

Compressed Air Locomotive.—One with cylinders and motion similar to a steam engine, but the boiler replaced by a reservoir charged with compressed air from some central point.

Compressed Steel.—Steel made by a process which is claimed to furnish a denser and sounder material than ordinary methods. The fluid molten steel is cast into ingots of the desired form, which are cooled under pressure from a hydraulic press, while yet in the moulds. The pressure applied varies from six to twenty tons per square inch,

Compressibility of Gases.—Owing to the perfect freedom of motion among the molecules of a gas, it is possible to compress gases to a very great extent, reducing a given volume to many times less than its normal bulk. The pressure generally varies in inverse ratio to the volume, according to *Boyle's Law*.

Compressibility of Liquids.—As with gases, liquids can offer no resistance to change of shape, only to change of volume. Their resistance to this latter is very great indeed, and can only be ascertained by delicate experiments; a pressure of one atmosphere will compress a volume of water about .0000466 of its bulk, and a volume of alcohol only .000216. This is so slight that it may be neglected in engineering.

Compressibility of Solids.—This varies greatly; with metals and many elementary substances it is so small as to be neglected in engineering, but with highly complex substances, especially those of organic origin, it is often very large, as for instance, with most woods, cork, india rubber, etc.

Compression.—1. In physics, the reduction in length, area, or volume of a body, which is occasioned by the application of external force or pressure.

2. In steam engineering, to press together or into smaller space; reduce in volume; as, steam behind the piston on the exhaust stroke, after *exhaust closure*.

3. In gas making, to compact or concentrate; as, to compress gas.

4. In gas and oil engines, the reduction in volume of the explosive mixture or charge after it has been drawn into the cylinder.

Compression Coupling.—In millwrighting, a coupling in which the fit is made between the bore of the coupling and the shafts which it unites, by drawing them together with wedges or bolts.

Compression Line.—That line on an indicator diagram, corresponding to the compression phase of the cycle. In a card from a *steam engine*, it represents the increment of pressure due to compression of the exhaust steam behind the piston; in a card from an *air compressor*, it is approximately a hyperbolic curve much resembling the expansion line of a steam card; in a diagram from an *explosion engine*, it corresponds to the compression of the drawn in charge, preparatory to ignition. Also termed *compression curve*.

Compression Process.—In refrigeration, a system employing a volatile agent having a low boiling point, such as ammonia, carbon dioxide, methyl ether, sulphurous acid, etc. The volatile agent is drawn into the *compressor*, and forced by it into a *condenser* or *liquefier*, where it meets with cooled surfaces, parts with its latent heat, and becomes liquid under pressure. It is then released through the *regulating* or *expansion valve*,

into the *expansion pipe*—colls of piping or the like within an insulated space or *refrigerator*—there the liquid encounters a low pressure only and volatilizes into gas, absorbing the heat necessary for the transformation from the surrounding air or liquid, chilling or freezing the latter by the abstraction. The expanded gas is exhausted by the suction stroke of the compressor, and the process is repeated continuously.

Compression Space.—The clearance volume above the piston in an internal combustion engine, into which the charge of inflammable vapor and air is compressed preparatory to the explosion.

Compression Tap or Cock.—A small pet-cock fitted on the cylinder of an internal combustion engine, to relieve compression, and facilitate turning by hand, or *cranking*.

Compressive Stress.—In engineering, a load producing a compressive strain, or one that tends to shorten a body in the direction of its length; a stress which has a crushing effect; as, that exerted on a column.

Compressor.—1. A machine for compressing air or other gases, notably carbon dioxide or ammonia in connection with refrigeration. It consists essentially of a single or multiple pump, within whose cylinders compression is effected by the return stroke of the piston after it has drawn in the gas on its previous stroke in the other direction.

2. In shipping, a lever for checking the running out of the cable. This has been modified into a sort of friction brake checking the rotation of the *gipsy wheel* which pays out the cable when the anchor is let go.

3. In ordnance, a compression brake for checking the recoil of the gun carriage on its slide; the compressor is released when the gun has to be run up again.

Computation.—The act or process of counting, reckoning, or estimating. In mathematics the term is generally applied to long and elaborate calculations.

Computing Machine.—A calculating machine, usually for adding, keys being pressed to correspond with the digits of each number of a series, the sum of the whole is finally shown by the machine.

Con.—In navigation, to conduct or superintend the steering of a vessel; to watch the course of a vessel and direct the helmsman how to steer.

Concave.—Depressed or indented with curved outlines; a surface which is part of the interior of a hollow sphere; opposed to *convex*.

Concave Saw.—A circular saw of a cup shaped form used to shape barrel heads. The three pieces forming the head are doweled together and clamped, being then fed to the saw in a circular path, thus at one and the same time cutting the head to size and beveling the edge to fit into the croze.

Conceal.—1. To enclose or surround, as with a railing or with lattice work.

2. To shut out, as with a railing or with lattice work; to exclude.

Concentrate.—1. To bring to a common center or point of union; to direct divers forces or means upon one particular point or object.

2. To intensify the properties of anything by removal of extraneous matter or of that which tends to weaken or lessen the special qualities or properties of the substance concentrated.

3. To bring to a more compact or condensed form.

Concentrated Load.—In mechanics, a localized load or stress bearing upon one particular point of a beam or similar structure. Other things being equal, a *concentrated load* has twice the effect of a *distributed load*.

Concentrating Brine.—In refrigeration, the process of evaporating excess water from the circulating medium, to maintain its proper strength.

Concentration.—1. The act or process of intensifying or condensing to a stronger or more compact form, as by evaporation of water or other solvent from a solution, rendering the remainder more active or powerful.

2. In metallurgy, the process of collecting the valuable portions of metallic ores, either by gravity, the affinity of mercury, or magnetism.

Concentric.—Having the same center; said of circles described within one another. Thus a piston rod, when true, is concentric with its cylinder, etc.

Concise.—Expressing much in a few words; condensed; brief and compacted; short.

Conclude.—To shut up; to enclose; to include; to bring to an end; to close; to finish.

Conclusion.—The last part of anything; close; termination; result.

Concord.—A state of agreement; harmony; union; to agree; to act together.

Concrete.—A mixture of Portland cement, sand and some coarse material, such as gravel, broken stone, etc.; much used for foundations, heavy masonry and engineering structures generally. Moulds or *forms* are constructed of timber to the desired outlines, and the concrete, being mixed with water, is placed within the mould until it is full, when, after a proper interval for *setting* or drying, the boards of the form are removed, leaving the structure a solid.

Concrete Blocks.—Blocks made of concrete and used in the construction of buildings, breakwaters, etc. They are made by mixing cement, sand and stone, wet or dry, and depositing this mixture in forms. They are called also artificial stone on account of their resemblance to stone.

Concrete Mixer.—A machine, usually steam driven, employed by contractors, consisting essentially of a double conical drum or churn, rotating upon its axis and provided with tilting gear for discharging the incorporated materials.

Concrete Number.—In arithmetic, a number of actual things as distinguished from a purely abstract number; thus, seven is an abstract number, as it is assumed for arithmetical purposes only, while seven dollars is a concrete sum or number, actually tangible.

Concretionary.—Formed by growing together, as in the familiar examples of flints and the nodules of clay iron stone. These concretionary structures are due to chemical action, proceeding under obscure conditions; their growth is due to the concentration of various substances, while in solution, around some nucleus in the rock. This process of concretion or aggregation frequently goes on until the nucleus has gathered around itself all the substance within what might be termed its range of attraction or the limit of migration.

Concretor.—An apparatus for reducing sugar to a solid crystal by evaporation.

Concussion.—A shaking or agitation; a shock, caused by the collision of two bodies.

Condensation.—Reduction in bulk of any substance accompanied by increase in density. Specifically applied to the transformation of heated vapor into liquid by contact with a cold body, as the condensation of exhaust steam in an engine.

Condense.—To compress; to contract, to crowd; to thicken; to concentrate; to be reduced into a denser form.

Condenser.—1. In steam engineering, an apparatus in which the exhaust steam is reconverted into water, either by mingling with a spray of cooling water, or by contact with cooled surfaces. The first process is termed *jet condensation*, the second, *surface condensation*.

2. In distillation, etc., a vessel or piece of apparatus wherein vapors or gases are reduced by similar means, to a liquid form.

3. In gas making, a range of pipes or the like wherein the products of distillation are sufficiently cooled to deposit tar and many watery impurities from the gas. The condensers are either cooled naturally by the atmosphere, or artificially by water trickling down outside them, this depending upon climatic conditions.

4. In a microscope, a lens fitted to give a powerful illumination of the object viewed.

5. With cotton, an attachment to a *gin* which compresses it for convenience in handling.

6. In textile manufactures, a contrivance at the delivery end of a carding machine, which operates upon the *slivers* as they pass out, giving them a slight twist by the transverse vibration of a roller under which they pass; this converts the fluffy threads into loose ropes termed *slubbing*.

Condensing Engine.—A steam engine in which the exhaust steam is condensed instead of being discharged into the air.

Conditioning.—A term with varied applications in the arts; especially:

1. The act or process of testing to ascertain the quality or condition of materials.

2. To bring to a proper state or condition for certain processes of manufacture.

3. To restore anything to its former condition after a special process; as, cotton yarn, when taken from the spindles, contains three per cent. less than its natural moisture. This is restored by keeping it for a few days in a damp place.

Condition of Sale.—The terms on which it is proposed to sell property by auction; also the instrument containing or expressing these terms.

Conduct.—The act or method of conducting; guidance; that which carries or guides anything.

Conducting Surfaces.—Those surfaces of a steam generator which are directly arranged for the transmission of heat; as, the heating surface of a boiler which is a *conducting surface*.

Conduction.—In physics, the transfer of heat from the hotter to the colder parts of a body. Hence conduction depends upon the fact of inequality in temperature existing in the several portions of a body. The transfer of heat through solids; as through boiler plates, is due to *conduction*.

Conduction of Heat.—The transfer of heat through substances, from one substance to another in contact with it. Any body which transmits heat rapidly is called a *good conductor* of heat; one that passes heat slowly is termed a *bad conductor*. Homogeneous bodies such as metals are the best conductors; those which are finely fibered such as cotton, wool or wadding; or are finely subdivided as charcoal dust or pulverized cork, are the worst conductors of heat. A bad conductor is also known as a *non-conductor* or *insulator*.

Conductivity.—The relative value of a material, as compared with a standard, in affording a passage through itself or over its surface of *heat*.

Conduct Money.—In navigation, a portion of a seaman's wages retained till the end of his engagement, and paid over only if his conduct has been satisfactory.

Conductor.—1. The traveling official in general charge of a railway car or train, having supervision over car porters, brakemen, etc. His duties vary with the different methods of railway working—on some systems, the conductor accompanies a car or train, for the benefit of through passengers, when it traverses a number of different railroads or runs across the frontiers of different countries—on other systems, he may collect fares, issue or collect tickets, and be responsible for the running of the train, conjointly with the engineer.

2. In well boring, a large pipe of wood or sheet iron serving to case the upper portion of a drilled well, to retain the surface soil.

3. In building, a rainwater shoot or vertical pipe leading the rainfall from the eaves troughs to the ground or sewer.

Conductor Head.—In plumbing, etc., the bell or enlargement at the upper end of a rainwater *conductor*.

Conduit.—In civil engineering, a pipe or passage, usually covered, for conducting water under dams, railroad beds, etc. Conduits are also largely used in the city for holding in the proper way, telephone and telegraph wires, etc. In subways and tunnels under rivers to connect two cities, the conduits are used for holding wires connected with the signal system, and form at the same time, a pathway for passage for employees working in the subway or tunnel, or for passengers in case of a blockade.

Cone.—1. In geometry, a solid figure described by the rotation of a triangle upon one of its sides as *axis*, or one which tapers uniformly from a circular base to a point.

2. In engineering, a stepped driving pulley for a machine tool, a *speed cone*.

3. The conical *race* for the balls in certain ball bearings.

4. In iron making, the swinging bell shaped part which closes the mouth of a blast furnace, and upon which are fed the ore, fuel, flux materials, etc.

Cone Bearing.—A shaft bearing in which the journal is turned to a conical or taper form, and the bearing bored to correspond; common in railway cars, and in certain other vehicles.

Cone Centers.—Conical points revolving upon mandrels, the latter fitting into the centers of a lathe headstock. These afford a convenient method of chucking pipes, etc., which require to be turned or threaded in a lathe.

Cone Chuck.—In turning, a chuck for a lathe containing a cone plate for the reception of the ends of shafts.

Cone Clutch.—A friction clutch, in which there are two cones, male and female, the engagement of which entails the minimum of movement of the parts, at the same time exposing a large area to friction.

Cone Joint.—A species of union or flanged joint, in which tight connection is made between pipes, etc., by means of ground male and female cones.

Cone Key.—In machinery, a form of key used for retaining a wheel or pulley in place, when the hole in the wheel is larger than that portion of the shaft upon which it is keyed. The wheel is bored slightly conical and a conical ring turned to fit in the bored hole and to embrace the shaft. It is then slotted into three parts, forming three separate keys. The wheel is thus maintained concentric with the shaft, and will pass over a larger to a smaller section without the necessity for splitting it.

Cone Mandrel.—A swage block of conical form used by blacksmiths upon which rings, etc., may be shaped.

Cone Plate.—In turning, a device for operating upon the ends of shafts in a lathe. A steady is provided with a number of holes for various diameters, these holes being coned or tapered towards the dead center; the bar to be operated upon is held, one end on the live center and the other in a suitable cone of the cone plate steady, thus leaving the end free to be bored, etc., as required.

Cone Pulley.—1. In machine tools, a stepped pulley of different diameters for varying the speed.

2. In spinning, a long pulley tapering from one end to the other, used for regulating the speed of the bobbins, so that, as they are filled with yarn, the number of rotations is decreased, maintaining an equal surface speed.

Cone Valve.—A hollow valve having a conical, perforated face, through which water is discharged when the valve rises, without impinging directly upon the valve face or seat.

Confidence.—Trusting; or putting faith in; trust; reliance; belief; the state of mind characterized by one's reliance on himself, or his circumstances.

Configuration.—Form, as depending on the relative disposition of the parts of a thing; shape; figure.

Confine.—To restrain within limits; to restrict; to limit; to shut up; to enclose; to keep close.

Confirm.—To make firm or firmer; to add strength to; to establish; to give new assurance of the truth of; to render certain.

Conformator.—An apparatus used by hatters to ascertain the shape of the head. It has the form of a hat brim or crown in which are some sixty small branches of ebony and steel. These adjust themselves to the shape of the head by springs, and are then locked in position. By a suitable mechanism, a copy of the cavity is obtained and this is used as a model for a block on which to build the hat.

Confuse.—To mix or blend so that things cannot be distinguished; to jumble together; to confound; to render indistinct or obscure.

Congevaler.—In refrigeration, the brine tank of an ice making machine.

Congelation.—The act or process of freezing.

Conglomerate.—A rock formed by water worn gravel or pebbles, bound together by cementing materials.

Congratulation.—An expression of sympathetic pleasure.

Congress.—A meeting of individuals, whether friendly or hostile; a gathering or assembly; a conference; the collective body of senators and representatives of the people constituting the chief legislative body of the nation.

Conical Rivet.—In iron work, a rivet whose head is conical in section. It is easier to hammer than the ordinary rivet in a restricted space where a small hammer only can be used.

Conical Wheel.—A wheel shaped like the frustum of a cone, and used in many ways; as a roller for turning curves in moving heavy bodies; the cone pulleys are forms of wheels for changing speed used in spinning machines and lathe heads; the *fusee* is a conical wheel with a spiral track for the chain.

Conic Sections.—Curves formed by the intersection of a plane with a cone. Thus, (a) if the plane cuts the cone at right angles to its axis, the section is a *circle*; (b) a transverse plane inclined to the axis cuts off an *ellipse*; (c) a plane parallel to one side of the cone makes the curve known as the *parabola*; (d) any other plane at a greater angle than the parabola forms the *hyperbola*.

Coning.—In railway engineering, the turning of the *taper* on the diameters of railway wheels, and crane and turntable rollers. The object in coning a railway wheel is, that as the train runs round a curve, and the wheels are thrown outwards by centrifugal force, the outer wheel may run on the rail where its diameter is greater, and the inner and outer curves shall be compensated for by the difference in the diameter of the wheel.

Conjugate.—1. United in pairs; yoked together; coupled.

2. In chemistry, containing two or more radicals supposed to act the part of a single one.

3. In mathematics, presenting themselves simultaneously and having reciprocal properties; frequently used in pure and applied mathematics with reference to two quantities, points, lines, axes, curves, etc.

Conjugate Axis.—In mathematics, the axis of a conic section which is perpendicular to the major axis—the *minor axis*.

Conjugate Mirrors.—In optics, two mirrors so placed that rays from the focus of one are received at the focus of the other, especially two concave mirrors so placed that rays proceeding from the principal focus of one and reflected in a parallel beam are received upon the other and brought to the principal focus.

Conjunction.—1. The act of conjoining, or the state of being conjoined, united, or associated; union; association.

2. In navigation, the meeting of two or more stars or planets in the same degree of the zodiac.

Connecting.—Attaching; joining one to another; affording means of communication between.

Connecting Link.—A link which has a movable section by which it may be made an intermediate connection between two links of a broken chain. The *open ring* or *lap ring* is a form of connecting link used in attaching a single tree to a double tree, and the latter to the plow clevis.

Connecting Rod.—In engineering, a vibrating link employed to connect a crank or similar rotating part with a reciprocating portion of the mechanism. Particularly, the rod which connects the piston rod cross head and crank pin of the direct acting engine.

Connecting Rod Bolts.—The bolts securing the crank pin end of a connecting rod, holding rod, brasses and cap together.

Connection.—An attachment whereby a person, instrument, or machine may make communication with a means of transportation or communication, or source of supply of anything.

Conoid.—Approximating in shape to a cone; as, a sugar loaf, or the point of a projectile.

Consecutive.—Following in a train; succeeding one another in a regular order; successive; uninterrupted in course or succession.

Consent.—Agreement in opinion or sentiment; the being of one mind; approval.

Consequent.—The second term of a ratio. The *Terms* of a ratio are the two numbers compared. The *Antecedent* is the first term of a ratio, the *Consequent* is the second term, and the two terms together are called a *Couplet*.

Conservation.—The act of preserving, guarding, or protecting; the keeping of a thing in a safe or entire state.

Conservation of Energy.—The doctrine of *physics*, that energy can be transmitted from one body to another or transformed in its manifestations, but may neither be created nor destroyed. Energy may be dissipated, that is, converted into a form from which it cannot be recovered, as is the case with the great percentage of heat escaping with the exhaust of a locomotive or the condensing water of a steamship, but the total amount of energy in the universe, it is argued, remains constant and invariable.

Consideration.—Continuous and careful thought; examination; contemplation; deliberation; thoughtful notice.

Consign.—To give, transfer, or deliver, in a formal manner; as, by signing over into the possession of another, with the sense of permanence of possession; to give in charge; to intrust.

Consolidation.—The act or process of uniting; making firm; combination.

Constant.—1. A quantity or magnitude, derived from actual experiment, which is included as a factor in most formulæ, for the purpose of bringing theoretical calculations in agreement with experience.

2. The calculated value of certain invariable factors to facilitate computation. Thus, a marine engineer will calculate out for each cylinder, area of piston in square inches \times twice stroke in feet = 33,000 and then to obtain the indicated horse power at any time, all that is necessary is to multiply this *constant* by the mean pressure from the indicator card and the revolutions per minute.

Constant Load.—In physics, a load whose pressure is steady and invariable. Structures subject to a dead or constant load undergo less stress than those on which the load is variable; therefore, a lower factor of safety suffices.

Constant Oil Feed.—An automatic lubricating device, akin to a chain or ring lubricator.

Constant Pressure.—In thermodynamics, a theoretical state in which a fluid does work or has work done upon it without increase or decrease of pressure; assumed for the work done in a cylinder before steam is cut off and expansion begins.

Constituent.—One of the parts or ingredients which go to form any particular whole; an elemental portion of a compound.

Constitutional.—Belonging to, or inherent in the constitution or structure of body and mind; in accordance with, or authorized by, the constitution of a state or society; regulated by, dependent on, or secured by, a constitution.

Constrict.—To draw together; to render narrower or smaller; to bind; to cramp; to contract or cause to shrink.

Constricting Brake.—In motor cars, a form of brake applied by tightening a band around a pulley, instead of applying a friction shoe. The same as *band-brake*.

Constricting Clutch.—A friction clutch, in which the outer part constricts or is tightened around the inner when the clutch is engaged or thrown into gear.

Construct.—To put together the constituent parts of something in their proper place or order; to build; to form; to make; as, to construct a building.

Construction.—1. Building up or erecting; the erection of a structure from previously formed elements.

2. In architecture, the planning, designing and erection of a structure; the setting up of plant and all processes preparatory to active productive operation.

3. In civil engineering, the building of such public works as roads, railways and canals, as differentiated from the subsequent work of maintaining and repairing them.

4. In mathematics, the building up of a thesis or the delineation of certain figures, in accordance with previously demonstrated principles, whereby the solution of a problem may be attained or some theorem demonstrated to be correct; this is especially applied in *geometry*.

Construction Engineer.—An engineer responsible for constructive work; the term is applied especially to a civil engineer, subordinate to the chief engineer of a railway, but who is in charge of all new works for the line, as against the other department having responsibility for *maintenance* of existing structures and works.

Construction Line.—In railway work, a temporary track, usually of standard gauge, laid down to assist in the construction of a railway line, used for the transport of spoil from *cut* to *fill*, or of materials and workmen.

Construction Way.—In civil engineering, as distinguished from the finished or permanent way of a railroad. It is a temporary way used in transporting gravel, timber, rails, or transporting and obtaining earth, etc., from other points where the cuttings for the track do not furnish it. It generally keeps its name until the main road is in running order and opened for the public service.

Consul.—An official commissioned to reside in a foreign country to care for the commercial interests of the citizens of the appointing government, to protect its seamen, etc.

Consultation.—The act of conferring; deliberation of two or more persons on some matter with a view to a decision; a council or conference; as, of civil or mechanical engineers, held to consider a special project.

Consulting Engineer.—An engineer, civil, mechanical or electrical, generally of high standing and long experience, who acts as an expert, giving advice to non-technical firms, public authorities or private individuals with regard to technical matters. Often, the services of a consulting engineer include responsibility for the whole of the conduct of the engineering side of a business, especially with steamships, steam plants, etc.

Consume.—1. To destroy by resolution into parts which may not be reunited; as, by burning, or chemical processes.

2. To destroy or waste, in application to its natural uses; as, with fuel and water.

Consumption.—The act or process of consuming by use, waste, etc.; decay; destruction; the state or process of being consumed, wasted, etc.; decline.

Contact.—1. The act of touching. The relation of superposed surfaces to each other, the extent of their coincidence being the measure of the perfection or otherwise of the contact.

2. Two or more surfaces abutting on each other in such manner as to afford conduction to heat, etc.

Contain.—To hold within fixed limits; to comprise; to include; to enclose; to hold; to have capacity for.

Contamination.—To soil, stain, pollute, or corrupt by contact.

Contemporaneous.—Living, existing, or occurring at the same time.

Contention.—A violent effort or struggle to obtain, or to resist, something; to contest; strife; quarrel; controversy.

Contest.—To contend for; to call in question; to oppose; to dispute; to debate; to argue.

Contiguous.—In actual contact, touching; also, adjacent; near; neighboring; adjoining.

Continued Fraction.—In arithmetic, a complex fraction whose numerator is a whole number, having for denominator a whole number plus a fraction whose numerator is a whole number and whose denominator is a whole number followed by a fraction, etc., as

$$\frac{3}{4 + \frac{5}{6 + \frac{7}{8 + \frac{9}{10}}}}$$

Continuous.—Without break, cessation or interruption; without intervening space or time; uninterrupted; unbroken.

Continuous Brake.—In railway working, a brake, so fitted to every car of a train, that it may be applied from any one of them, and there control the remainder.

Continuous Jigger.—In mining, a concentrating machine for ores, box-shaped, with a flat sieve for the ore in one compartment, and a power-driven piston in the other; being full of water, the motion of the piston lifts the ore up and down, arranging it according to weight, the richest accumulating at the bottom. Means are provided for continuously taking away the waste and the rich ore.

Continuous Paper.—Drawing and tracing paper prepared and sold in rolls instead of sheets. Any length can then be cut for specially long drawings.

Contour.—1. The outline of a figure or a body; the line that bounds; periphery.

2. In civil engineering, the form of the ground surface with respect to its undulations.

3. In surveying, a horizontal plane intersecting a portion of ground.

Contract.—1. A legal instrument binding both parties, one to perform certain work in a specified manner, and the other to pay a certain stated remuneration for such work satisfactorily accomplished.

2. To shrink; the opposite of expand. To occupy a smaller space under diminution of heat, through the particles of material approaching closer to each other, the force of repulsion among them gradually decreasing as the temperature falls.

Contraction.—The act or process of shortening, or shrinking, the state of being contracted; as, the contraction produced by cold; in mathematics, the process of shortening an operation; in a foundry, the reduction in size of a casting from the time it solidifies until it cools.

Contraction Fit.—In machine shop work, a fit employed when a bore requires to be firmly and permanently fastened to a cylindrical piece as a shaft. The bore is turned to a smaller diameter than the cylindrical piece, then heated so as to expand the bore; the cylindrical piece is then inserted and the cooling of the bore causes it to contract upon the cylindrical piece with a force varying with the amount allowed for contraction. This fit is also called a *shrinkage fit*.

Contraction of Area.—The amount by which the area, at the point where a test piece has broken, is reduced below what it was before any strain or pulling force was applied. The contraction is usually expressed as a percentage, and is an indication of the ductility of the material tested.

Contraction Rule.—In pattern making, a rule in which the various divisions are made longer than the actual measurement by an amount proportionate to that which the casting contracts in passing from a molten to a solid state. Generally taken as $\frac{1}{40}$ inch to the foot in cast iron and $\frac{1}{16}$ inch per foot for brass. Also known as *shrink rule*.

Contractor.—An individual or firm who, by a legal agreement, undertakes to execute certain work for a stated remuneration. Usually signifying a firm of constructing engineers who carry out engineering enterprises such as railways, waterworks, etc.

Contrary.—In an opposite direction; in opposition; affirming the opposite.

Contrast.—To set in opposition, or over against, in order to show the difference between, or the comparative excellences and defects of; to compare by difference of qualities.

Contribute.—To give or grant in common with others; to give to a common stock or for a common purpose; to furnish or supply in part; to give money or other aid for a specified object.

Contrivance.—1. The act or faculty of contriving, inventing, devising or planning.

2. The thing invented or planned; disposition of parts or causes of design; a scheme; plan; artifice; arrangement; project; machine; shift.

Control.—1. To check; to govern; to exercise a restraining influence over.

2. The governing or restraining influence so exercised.

Controller.—In shipping, a cast iron block, with depressions in its upper face corresponding to the links of the chain, fixed upon the forward deck of a ship to control the paying out of a chain cable.

Convection of Heat.—The transfer of heat by the motion of the heated matter itself; it can therefore take place only in liquids and gases.

Convene.—To come together, as in one body, or for a public purpose; to meet; assemble; to congregate.

Convenient.—Fit or adapted; suitable; proper; appropriate; handy; seasonable; timely; near at hand; easy of access.

Convention.—The act of coming together; the state of being brought together; union; general agreement or concurrence; a meeting or an assembly of persons, especially of delegates or representatives to accomplish some specific object, civil, social, or political.

Conventional.—1. Arbitrary; established by custom or general usage.

2. Dependent upon accepted models or traditions for a formal representation instead of an actual copy of nature; purposely deviating from natural forms for good reasons although adhering to the principles which underlie them, as in heraldry, the figures on coins, etc.

3. Arbitrary systems of shading and lining whereby different materials or colors are depicted in black and white, as in *mechanical drawings*.

Converge.—To cause to tend to one point; to cause to incline and approach nearer together.

Convergence.—1. Mutual approach towards each other, as with two lines which are not parallel.

2. In *mathematics*, the gradual drawing closer of the value of an infinite arithmetical or algebraic series towards a quantity, known as its *sum*, which is ever approached but never attained, as in the converging series: $\frac{1}{2} + \frac{1}{4} + \frac{1}{8} + \frac{1}{16} + \frac{1}{32} + \frac{1}{64}$, the total always converges on 1, but never attains it, no matter how far the subdivision is carried.

Converse.—To engage in familiar talk, to interchange thoughts and opinions in a free, informal manner; to chat.

Conversion.—1. The act of turning or changing from one state or condition to another; or the state of being changed; transmutation; change.

2. In *mathematics*, a change of reduction of the form or value of a proposition; as the *conversion* of equations; the conversion of proportions.

Converter.—1. In steel making, an egg-shaped retort, mounted on trunnions, which, in the Bessemer process, is filled with molten pig iron, tilted at a suitable angle, and air blown through until the spectroscopic shows the combined carbon to be burnt away. A proper proportion of spiegel-eisen or ferromanganese is added, to give the proper percentage of carbon, and after a little further agitation the charge is run off to be cast into ingots.

2. In copper smelting, an apparatus similar to the above, in which sulphur, arsenic, etc., are burnt off from the *matte*.

3. In gold mining, an arrangement of crucibles through which chlorine gas is passed to separate silver from gold while in a molten state.

Converter Lining.—With the acid Bessemer process, this is usually ganister or similar highly refractory material

containing much silica. In order to eliminate phosphorus, a basic lining of dolomite or of magnesia, lime and mill scale is substituted.

Converting.—In iron and steel works, decarbonizing, or changing cast iron into steel.

Convex.—Rising or swelling into a spherical or rounded form; bulging; said of a spherical surface or curved line when viewed from without, in opposition to *concave*, which signifies a rounded form of the *interior* surface.

Convex Lens.—One having a protuberant form. A *plano-convex* lens has one flat and one bulging side.

Convey.—To carry from one place to another; to bear or transport; to transfer.

Conveyance.—The act of conveying, carrying or transporting; the vehicle in which, or means by which, anything is carried from one place to another.

Conveyor.—1. That which conveys, transports, transmits, imparts or transfers.

2. Any mechanical contrivance for conveying material in the working of mills, elevators, etc., as *endless chains*, *screw conveyors*, etc.

Conveyor Flight.—A portion of a spiral conveyor, usually half a turn, these being made in uniform pieces for convenience in manufacture and assemblage of the conveyor.

Cooler.—In refrigerating systems, an apparatus akin to the evaporative condenser, in which the liquid to be cooled pours in a thin film or spray over coils of pipes, inside of which liquid ammonia is permitted to escape into a gaseous state thus, absorbing heat from the liquid flowing over the pipes.

Cooler Cock.—In a locomotive, a small cock or valve fixed to the side of the tender water tank, and provided with a small flexible hose for cooling heated bearings, etc. Also termed *flood cock*.

Cooling Plates.—In metallurgy, hollow cast iron plates arranged in rows above and between the tuyeres of a blast furnace, to keep the walls, etc., cool by circulating water.

Cooling Pond.—A reservoir supplying condensing water to a mill engine, affording a large area for cooling it as it returns from the circulating pump discharge. Also known as *lodge*.

Cooling Surface.—In a surface condenser, the area exposed to the steam or other vapor by the tubes, etc., cooled by circulated water. If the vapor be *outside* the tubes, as in steam engineering practice, the cooling surface is calculated on the external diameter of the tubes, if the vapor be *inside* them, as in an ammonia condenser, it is calculated on the bore of the pipes.

Cooling Tower.—An apparatus intended to dissipate the heat from the condensing water of a power plant, where the supply is limited or the value of land prohibits a cooling pond or lodge. Essentially, it consists of a tower or stack, from the top of which the heated circulating water is sprayed over a cellular construction of brushwood, earthenware pipes, wire mats, diaphragms or other *baffles*, designed to expose the water to the cooling influences of the atmosphere while in a film or fine rain, the process being assisted by the evaporation of part of its bulk. Counter air currents are maintained by side ventilation, natural draught (using the tower as a chimney), or by a fan blast. The cooled water collects in a tank or *sump* within the foundations, and its decrease by evaporation is made up from the public water mains or a well.

Cooling Water.—The injection or circulating water for a condenser, with steam or other heat engines or with refrigerating plants. The necessary quantity depends upon the nature of the machinery, but to secure economical working of an ammonia plant, a constant supply at about 55° F. is desirable.

Coom.—A term applied to refuse matters, such as soot, smoke black, coal dust, the *mold* which forms on some liquids, the *drip* of journal boxes, etc.

Cooper, Peter.—Born 1791, died 1883. An American manufacturer, inventor and philanthropist. He was engaged in various employments until in 1828, he erected the Canton Iron Works in Baltimore, and soon after built a rolling and wire mill in New York City, and blast furnaces in Pennsylvania; in 1830 he designed and built the first locomotive actually used in America, and in 1854 made the first rolled iron beams for structural purposes; he was one of the first promoters of the Atlantic cable, and (1853) established the institution in New York City, known as Cooper Union, for giving educational advantages to working men and women who would otherwise be deprived of them.

Cooper.—A cask maker; one who constructs barrels, vats, etc., from shaped and fitted wooden staves, securing them with hoops of wood or iron.

Cooperage.—A place where wooden vessels such as casks, tubs, etc., are built; a general name for all utensils or receptacles built up of wooden staves.

Co-operation.—1. Combined effort or labor; the act of joint operation or acting together for one end.

2. Mutual trading whereby an association buys commodities at wholesale and retails them to its members, thus eliminating all charges or profits save those necessary for handling or storing the goods.

Cooper's Adze.—A light adze wielded with one hand, used by coopers in trimming the staves of a cask, etc.

Cooper's Driver.—A steel block with a long wooden handle, which transmits the blows of the hammer to hoops around casks, tanks, etc., when they are driven to tighten the staves; a *hoop driver*.

Co-ordinate.—1. A thing of the same rank with another thing; one of two or more persons or things of equal rank or authority.

2. Lines, or other elements of reference, by means of which the position of any point, as of a curve, is defined with respect to certain fixed lines, or planes, called *co-ordinate axes* and *co-ordinate planes*.

Cop.—In spinning, a conical shape into which rovings, etc., are wound, so as to be easily slipped off; also applied to the double cone or spindle shape in which yarn is supplied to the shuttle. The same name is used with woolen yarn. Also termed *coppin*.

Copal.—A name applied to a number of semi-fossil resins, flowing spontaneously from trees grown in Africa, East Indies, Central and South America. It is found in the ground near the root of the trees, that obtained from Sierra Leone and Zanzibar, being the best. Copal is largely used in the manufacture of the best *varnishes*, as it forms pale and very durable coatings.

Cope.—In moulding, the upper half of a flask or casting box; a *case*.

Cope Cutter.—In woodworking, a cutter for *under cutting* the shoulder of a tenon.

Coped Joint.—A carpenters' joint used instead of a miter to connect one moulding to another, as in window sashes. The end of one piece is carefully cut out to suit the profile of the moulding, and the two pinned together. Such a joint is generally equal in appearance to a miter and is not so liable to warp; it is employed where two different mouldings have to be joined.

Coping.—1. The course of masonry along the top of a wall.

2. A coating of impervious material upon the top of a wall.

3. The curb along the edge of a dock or pier.

Copper.—A common metal of a brownish red color, both ductile and malleable and very tenacious. It is one of the best conductors of heat and electricity. It is one of the most useful metals in itself, and also in its various alloys, such as brass and bronze. It is the only metal which occurs native, abundantly in large masses; it is found also in various ores, of which the most important are *chalcocypite*, *chalcocite*, *cuprite* and *malachite*. Mixed with tin, it forms bell metal, with a smaller proportion, bronze; and with zinc, it forms brass, pinchbeck and other alloys.

Copperas.—Ferrous sulphate, also known as *green vitriol* and green copperas, prepared either by the action of dilute sulphuric acid on iron, or by gently roasting iron pyrites in the air. It is largely employed in the manufacture of black writing ink, in dyeing, tanning, etc. On exposure to the air it loses its green color and turns brown through oxidation.

Copper Bit.—A pointed piece of copper, riveted to an iron shank and provided with a wooden handle. It is used for soldering. If not previously tinned, it is heated to a dull red in a charcoal fire; hastily filed to a clean metallic surface, then rubbed immediately upon a lump of sal-ammoniac and next upon a copper or tin plate, upon which a few drops of solder have been placed. This will completely coat the tool, which may be wiped clean with a piece of tow, and is now ready for use.

Copper Bottomed.—In shipbuilding, having the portion of the outer skin which is exposed to the water sheathed with copper, as a protection against that great boring insect, the *teredo*.

Copper Drift.—In machinist work, a short cylindrical piece of copper held with a twisted hazel rod and struck with a hammer; its uses being to prevent the ends of shafts or similar portions of bright finished work from being bruised or burred over. This would happen if they were struck directly with a steel faced hammer. The copper therefore acts as an elastic medium or cushion.

Coppered.—In navigation, sheathed with copper; as, a wooden ship.

Copper Fastened.—In shipbuilding, having the planking secured with copper nails, rivets and bolts; as in a *first class* timber built ship.

Copper Hammer.—A hammer used by engineers to avoid defacing bright or finished work. The head is usually of pure copper, although some forms have renewable copper tips, to an iron head.

Copper Mill.—A plant where copper ore is disintegrated by stamps, crushers or mills, and the resultant metal is concentrated and graded for smelting and refining.

Copper Pipe.—In steam engineering, copper is used for the steam and various other pipes of large engines, its utility consisting in the readiness with which it can be curved to any form and in the ease with which it accommodates itself by expansion and contraction to variations of temperature without risk of tearing off the flanges. The flanges of copper pipes are brazed on, a hole being bored through the flange to receive the pipe.

Copper Plate.—A polished sheet of copper upon which a design or writing is engraved or etched; an impression being subsequently produced on paper by suitably charging the plate with ink.

Copper Pyrites.—The commonest ore of copper, a double sulphide of copper and iron, sometimes containing some arsenical sulphide in addition.

Copper Smelting.—This is a lengthy and elaborate process effected in reverberatory furnaces or converters. The pyrites ores are roasted to liberate arsenic, and the temperature is then raised until the metal fuses, producing *cuprous sulphide* and *silicate of iron*; this silicate is removed as slag. By repeating the roasting and fusion, all the iron is removed. The cuprous sulphide is carefully roasted until it consists of two thirds oxide, the temperature is then raised until it becomes copper and sulphur dioxide. On remelting, the copper is *pooled* with green wood, to reduce the oxide remaining. Much copper is refined by *electrolysis*; the blister copper is cast into slabs for anodes, which decompose under the action of an electric current of low voltage and small amperage. The electrolyte is a solution of sulphate of copper, and the pure copper is deposited on a thin *cathode plate* of pure metal.

Coppersmith.—An artisan who works in sheet copper, manipulating it into various forms, such as vessels, pipes, etc., making necessary joints by means of brazing or hard soldering.

Copping Rail.—In weaving, the bar on which the bobbin rests in a spinning frame, giving it an up and down motion so that the yarn is coiled.

Copra.—The dried kernel or *meat* of the cocoanut, from which is pressed cocoanut oil, much used in soap and candle manufacture, and, in the tropics, as an article of food and a lamp oil.

Copy.—1. To make a copy of; to make in duplicate.

2. In printing, manuscript or printed matter to be reproduced in type by a compositor.

3. A single book or a set of books.

Copying Ink.—A peculiar ink used for writings of which copies by impression are to be taken.

Copying Lathe.—A species of profiling machine, having two parallel beds with headstocks geared together, the copy or pattern being revolved in one lathe, and the stock to be operated upon in the other. A circular wheel of the same diameter as the revolving cutter is placed at one end of a swinging beam opposite to the lathe, and, as the copying wheel and consequently the beam is swung in and out by the revolving copy, the cutter approaches and recedes from the revolving stock, thus reproducing all irregularities of form.

Copying Press.—A screw press whereby facsimiles of letters or manuscripts are transferred under pressure to dampened paper. The ink with which the writing is made is of a viscid nature and is absorbed by the porous copying paper, being easily legible through it on account of its transparency.

Copying Process.—A form of photographic reproduction of drawings, plans, etc. This is effected either by taking an ordinary negative from which it is printed, or else is done by contact printing, using either the *blue print process* or that for *black printing*, elsewhere described.

Copyright.—The sole right to produce after *publication* (with printed matter), or *exhibition* (with works of art, plays, etc.), copies of a book, article, play, musical composition, painting or drawing, print, photograph or piece of sculpture. In America, copyright lasts for 28 years plus 14 years on re-registration; in England, it is for forty-two years or for the period of the author's life.

Coral.—Deposits of calcium carbonate, secreted by the coral insect. These range from huge masses, like the Great Barrier Reef of Australia, 1200 miles long, to most delicate and flowerlike tracery, and are in every case the skeletons and cells of countless myriads of tiny workers.

Coral Reefs.—Reefs often of great extent, made up chiefly of fragments of corals, coral sands, and the solid limestone resulting from their consolidation. They are classed as *fringing reefs*, when they border the land; *barrier reefs*, when separated from the shore by a broad belt of water; *atolls* when they constitute separate islands, usually enclosing a lagoon.

Corbel.—1. In carpentry, a block of timber resting on a post, and supporting the ends of timber girders.

2. In architecture, a form of bracket used in Gothic architecture to support the ends of cornices, arches, parapets, etc. It is a projecting block of stone, usually carved and with a receding face.

3. In masonry, bricks are also said to be *corbelling* when the courses overhang each other, thus forming a continuous projection around the wall.

Cord.—1. A fine string or very small rope; a ligament. The term implies a closely twisted, fine spun material.

2. A measure of wood, employed in those districts where wood is burnt for fuel; the capacity of a stack of wood, 4 ft. high, 4 ft. wide and 8 ft. long, or 128 cubic feet. In the average cord of wood, there are 72 cubic feet of wood and 56 cubic feet of voids, or 9 to 7; the weight ranges from 1500 to 4000 lbs. For evaporative efficiency one cord of hard wood and one cord of soft wood, as used upon lake steamers, are held to equal 2000 lbs. of Pennsylvania anthracite; i. e., two cords of wood are equal to one ton of coal.

Cordage.—Ropes, halyards, falls, etc., as used in the running rigging of a ship, or for pulley and haulage systems ashore.

Corder.—An attachment to a sewing machine for the purpose of inserting a cord between two thicknesses of material.

Cording.—In weaving, the arranging of the treadles, etc., of a loom, so that they may move together in the manner requisite for the execution of the pattern.

Corduroy Road.—A temporary track laid across soft ground in unsettled regions; constructed by felling timber, and laying the logs side by side transversely to the roadway, a sprinkling of sand or clay being used to fill up the hollows and interstices to render it easier for wheeled traffic. So called from the surface of the road resembling *corduroy cloth*.

Cord wood.—Wood cut and piled for sale or use by the cord, in distinction from long wood; especially, wood cut to the length of four feet.

Core.—1. The central or innermost part of a thing; heart; as, the *core* of a rope, boil, etc.

2. In engineering, the round plug of rock brought out in boring with an annular drill.

3. In hydraulic engineering, a wall or structure impervious to water placed in an embankment or dyke to prevent the percolation of water, which may penetrate the porous material of which the remainder of the dyke is composed. The core may be a puddle or a wall laid in hydraulic cement.

4. In moulding, that separate part of the mould which occupies the portion of the

casting intended to be hollow. For *loam moulding*, the core is generally formed of clay on a foundation of straw bands rolled around a perforated cylinder; in *green sand moulding*, it is made of sand with adhesive material and commonly baked before use.

Core Bar.—In moulding, an iron or wooden rod or bar on which a core is made.

Core Barrel.—1. In moulding, an iron or wooden pipe, covered with straw bands and loam to make the foundation of a large core.

2. In boring, a tubular stem, placed above the annular cutter of diamond or similar drills, to receive the specimen core.

Core Box.—In founding, a mould in which foundry cores are rammed up from black sand and binding materials.

Core Lox Clamp.—In moulding, a strong clamp used to hold together the two halves of a core box, while it is being rammed.

Cored Hole.—1. A cast hole which is cored with a dry sand core instead of a hole to be made directly from the pattern.

2. In a foundry, generally any hole in a casting which is not bored in the machine shop. It is customary in drawings to distinguish rough cast holes from those which are to be bored, by the use of this term.

Core in Ice.—In refrigeration, when *can* ice is frozen too rapidly more or less air may be entangled in the ice crystals making a white core or *feather* in the center. It may also be caused by carbonate of lime or magnesia in the water, and a *red core* may be due to oxide of iron.

Core Irons.—Rods of wrought iron from $\frac{1}{2}$ inch or $\frac{1}{4}$ to $\frac{1}{2}$ inch in diameter, according to the size of the core, which form a skeleton or framework upon which a foundry core is made and dried. Slender cores would fall to pieces, except for the assistance derived from core irons. After the castings are made the irons are withdrawn by hand or by pincers.

Core Maker.—A workman employed in foundries, whose duty is the striking up or ramming up of cores. The core maker is usually a moulder who has taken to this special department of the work and having acquired the distinctive knowledge relative thereto does not quit it.

Core Oven.—In moulding, a room or oven, heated by coke fires, in which the various cores used in a foundry are dried or baked preparatory to use.

Core Pipe.—In founding, a perforated pipe serving as foundation for a core. The same as *core barrel*.

Core Print.—In moulding, a projection on the pattern which forms a recess in the sand, affording accommodation for a corresponding projection formed on the core, retaining the latter in its proper position in the mould.

Core Sand.—In a foundry, sand used for making cores. It is a mixture of various sands whose names and qualities vary with the localities in which they are found. It has the property of hardening when dried.

Core Valve.—A plug valve which has a rotary turning motion in a hollow conical seat; occupying about the same relative position to its seat, as the core of a *faucet* does to the casting itself.

Corf.—1. In coal mining, a basket or square frame of wood to carry coal on.

2. A sled or low wheeled wagon in a mine, to convey coal or ore from the miners to the bottom of the shaft.

Corinthian.—In architecture, of or pertaining to the Corinthian order of architecture, invented by the Greeks, but more commonly used by the Romans.

Cork.—The outer bark of an oak grown in Spain, Portugal and Northern Africa. The cork oak may grow to a height of 40 feet, and has spreading foliage, and a massive trunk covered with rough bark, growing to a depth of some two inches. The first crop of bark is termed *virgin cork* (taken when the trees are about 15 years old) and is useless except for ornament. The cork is subsequently removed at intervals of 6 to 10 years, being replaced by the natural growth from the soft inner bark, the tree frequently being productive for 150 years. Cork is composed of an aggregation of minute air vessels with thin water tight and very strong walls, hence its lightness. Its remarkable elasticity renders it serviceable for many purposes, and its specific gravity of 0.25 causes it to be very buoyant, thus being adapted for *life buoys*, floats, etc.

Cork Cutting Machinery.—Machinery for cutting the bark of the cork oak into rectangular pieces and then trimming these to conical or cylindrical forms suitable for bottle stoppers. Many devices are employed, all utilizing the ideas of rapidly revolving cutters, which also have a drawing motion, as cork crumbles or breaks away under direct pressure. Attachments are also made to keep the blades keen, as an edge only slightly dulled is useless for the purpose. Exhaust and blowing fans are provided to remove and collect the chips and cuttings, as these are of considerable value for insulating cold storage chambers or for a non-sweating paint used on shipboard.

Cork Jacket.—A sort of life belt, consisting of canvas filled with cork pieces, shaped so that it may be strapped around the body, to assist a person in keeping afloat.

Corkscrew Staircase.—In carpentry, a winding stairs with a solid newel.

Corliss, George Henry.—Born 1817, died 1888. An American inventor and engineer famous for his improvements of the steam engine. In 1848 he commenced the manufacture of steam engines embodying important improvements of his own invention, and in 1856 his company was incorporated as the Corliss Steam Engine Co., which manufactured engines on a constantly increasing scale incorporating great improvements in construction, and insuring economy of operation; he conceived the idea of furnishing all the power for the Centennial Exhibition, in 1876, from a single engine, and designed and built the famous Corliss Engine for that purpose which gave him world wide fame. He was frequently honored by medals, diplomas and other distinctions at home and abroad.

Corliss Engine.—A steam engine fitted with Corliss valves. These are usually four in number for each cylinder, a separate steam and exhaust valve being provided at each end. The valves are shaped as a sector of a cylinder and vibrate within a cylindrical seat over ports in line therewith. The admission valves are not in positive connection with the valve gearing, but are tripped or disengaged at a point in the stroke determined by the governor or by hand, the closing being effected by a spring or equivalent device, thus giving a quick cut off, variable according to the load. The Corliss valve has the advantage of requiring little power to drive it, and has minimum clearance losses.

Corn.—To form into small grains; to granulate; as, to *corn* gunpowder.

Corner.—1. The point where two converging lines meet; an angle, either external or internal; the space between two converging lines or walls which meet in a point.

2. In moulding, a variety of sleeeking tools used to dress or smooth corners in a mould, and made to suit various shapes.

Corner Drill.—One driven by a crank and bevel gearing, being thus adapted to bore in places where the surrounding frame or machinery will not allow the revolution of the ordinary brace handle.

Corner Saw.—One for removing the corners of a block, giving it an octagonal shape. The saw mandrel is mounted in a head which traverses on ways parallel to the trough in which the block is placed. The block is slid in the trough, bringing it against the saw, and taking off the corners in succession. It is one of the series of *block making machines*.

Corner Stone.—The stone which lies at the corner of two walls and unites them; the principal stone; especially the stone which forms the corner of the foundation of an edifice; hence, that which is of fundamental importance.

Corn Huller.—In millwrighting, a machine for removing the hull or cuticle from grains of corn, without powdering the same.

Cornice.—In building, a group of mouldings surmounting a wall; the projecting mouldings which crown the entablature; in architecture, surmounting the frieze.

Cornish Boiler.—A cylindrical boiler with one longitudinal internal flue, the products of combustion passing around the shell of the boiler within the brickwork setting on their way to the chimney.

Cornish Pump.—A mining term, applied in the Western States to that style of mine pump in which a series of pumps are placed one above another in a shaft and worked by one common pump rod or *spear*.

Cornish Pumping Engine.—A form of single acting condensing steam pump. A heavy rod or plunger, raised by the steam, forces up the water by its weight in descending.

Cornish Valve.—The equilibrium or double beat valve as applied to pumping engines, so called from its origin together with many other inventions applied to draining mines, in the English county of *Cornwall*.

Corn Planter.—A machine for dropping corn in hills, previously opening the ground for the reception of the seed and subsequently throwing back the earth and rolling it flat.

Corn Sheller.—In grain machinery, an implement, in which corn is scratched from the *cob* by means of spikes on the face of a revolving cylinder.

Corollary.—In geometry, a *corollary* is a consequent truth derived immediately from some preceding truth or demonstration.

Corona.—In navigation, the irregular radial streams of light surrounding the sun, during an eclipse.

Corpuscle.—A minute particle; an atom; a molecule.

Correct.—1. Free from errors; not faulty or imperfect.
2. To set right or make straight.

Correction.—1. In navigation, an allowance made for inaccuracy in an instrument; as chronometer correction; compass correction.
2. The act of correcting, or making right that which is wrong.

3. That which is substituted in the place of what is wrong; an emendation.

Correspond.—1. To be like something else in the dimensions and arrangements of its parts; to be adapted; to suit; to agree.
2. To hold communication by means of letters.

Corridor.—In architecture, a long straight passage way in a building, opening out into rooms or apartments on either side; a passage along a compartment railway car, giving access to and communication between the different compartments.

Corrode.—To eat away by degrees; to wear away or diminish by gradually separating or destroying small particles of; as, by the action of a strong acid or a caustic alkali.

Corrosion.—Chemical action which causes destruction of the surface of a metal, usually by oxidation or *rusting*, though the metal may be also eaten away by the action of acids present in water or in the surrounding air. To diminish corrosion of exposed surfaces, paints, oils, or other protective coatings are employed. No process has yet been discovered which absolutely prevents corrosion, the best deterrents with machinery, etc., are care in fixing or placing the apparatus, suitable protection from the weather, elimination of dampness and accumulation of moisture, and intelligent care on the part of the persons in charge.

Corrosive Sublimate.—In chemistry, so called because obtained by sublimation, and because of its harsh irritating action on the body tissue. Usually it is in the form of a heavy, transparent crystalline substance, easily soluble and of an acrid burning taste. It is a *virulent poison* and also a powerful antiseptic.

Corrugated.—Formed with a surface consisting of alternate ridges and valleys, usually struck to a circular radius; as, *corrugated iron*.

Corrugated Furnace.—In engineering, a furnace flue, which is channeled or corrugated circumferentially, thus adding to its strength and yet providing means for dilatation or contraction.

Corrugated Iron.—Sheet iron pressed or rolled into semicircular corrugations and galvanized; much used for roofing purposes and for covering the sides of more or less temporary structures.

Corrugating Machine.—A machine for corrugating sheet metal. In one form, it is a rolling mill in which a series of parallel grooves, alternating with parallel elevations, is cut in the circumference of the central roll, and counterpart grooves and elevations are formed in the upper and lower roll, so that the iron is passed consecutively between the rolls in opposite directions. In another form, the rolls are grooved longitudinally; in still another, the corrugation is effected by simple pressure between dies.

Cort, Henry.—Born 1740, died 1800. An English ironmaster and inventor, sometimes called the "father of the iron trade." Realizing that British iron was inferior to that produced in Russia, he commenced a series of experiments for the improvement of the British product. In 1775, he established a forge and a mill, and, in 1783, he patented the so-called "puddle-rolls" for drawing iron into bars. The next year he patented the process known as "puddling" by which pig iron was freed from impurities and converted into malleable iron by the action of oxygen circulating over it when subjected to intense heat in a reverberatory furnace. This process greatly improved the manufacture of iron and gave immediate impetus to the iron industry.

Corundum.—A hard mineral consisting of crystalline alumina. Emery is a dark colored granular variety of the same. Corundum is used in powder of varying fineness, made up into wheels with resins, glue, etc., and is used in the form of different instruments, as files, slabs, wheels, etc. Glued to some cheap cloth it is used by metal workers, and known as *emery cloth*.

Corve.—In mining, a small four wheeled car with a hopper body, in which coals are brought from the workings to the surface. So called from *corb*, a basket, the article first used, replaced by an iron box, and then by a car.

Cosine.—In trigonometry, the sine of the complement of an angle. It may be represented as the length of the adjacent side or base of a triangle, of which the sine is the perpendicular or opposite side, or as the ratio existing between the adjacent side or base and the hypotenuse. Abbreviated as *cos.* or *cosin.*

Cosmical.—Also *cosmic*. Pertaining to the universe, and having special reference to universal law or order, or to the one grand harmonious system of things; hence, harmonious; orderly.

Cost.—The amount paid, charged, or engaged to be paid, for anything bought or taken in barter; charge; expenses, etc.

Coston Light.—In navigation, a hand firework throwing red fire, used for night signals.

Costs.—The charges incident to the manufacture of an article; the expense of production. To ascertain these accurately is the aim of shop bookkeeping, as, by apportioning charges under their proper heads, sources of loss may be made apparent.

Cosy.—1. Snug, comfortable, easy, contented.

2. A wadded covering for a vessel to keep the contents hot.

Cot.—1. In architecture, a small country house.

2. In manufacture, a cover or sheath; as, a roller cot, the clothing of a drawing roller in a spinning frame.

3. In navigation, a small rudely formed boat.

4. In geometry, an abbreviation for the cotangent of an angle.

Cotangent.—In trigonometry, the tangent of the complement of an angle. It may be represented as a right line which touches a circle without cutting it, at a point 90° from the tangent of the angle, and prolonged to the cosecant, or as the ratio existing between the base and the perpendicular of a triangle. Abbreviated to *cot.* or *cotan.*

Cotter.—A wedge or taper key used to fasten parts of machinery together.

Cotter Drill.—A drill for boring slots; it or the work having a lateral motion after its depth is attained.

Cotter File.—A narrow thin file used for cleaning out cotter holes, key ways, etc. It may be parallel or tapering; in the latter case it is termed an *entering file*, as it enters small holes or slits to enlarge them.

Cotter Pin.—A split key; properly a headless taper split pin, driven into its hole and expanded at the small end so that it cannot jar loose.

Cotter Plate.—In founding, a lug or flange on a moulding flask through which cotttered pins are passed to hold two boxes together.

Cotter Way.—The slot for the reception of a cotter. The sides are straight and parallel with each other, but the ends may be struck to a small radius and are tapered towards each other to permit the drawing action of the cotter; this taper varies from 1 in 12 to 1 in 30.

Cotton.—1. A soft, downy substance, resembling fine wool, consisting of the unicellular twisted hairs which grow on the seeds of the cotton plant. Long staple cotton has a fiber sometimes almost two inches long, short staple cotton from two-thirds of an inch to an inch and a half.
2. Textile material prepared from this fiber; as, cotton cloth.

Cotton Belting.—Driving belts made with several thicknesses of cotton duck, stitched together, and impregnated with a compound usually containing a red pigment and substances which render the belt waterproof.

Cotton Cords.—In machinery, driving cords used for working overhead travelers. They are about $\frac{1}{4}$ inch or $\frac{1}{2}$ inch in diameter and are remarkably soft and pliable. They run in grooved pulleys and under similar conditions to ropes.

Cotton Gin.—A machine used for separating cotton seeds from the fibers, consisting of a gang of circular saws revolving against a grating; the teeth of the saws pull the fibers away from the seeds which fall into the bottom of the machine while the fibers are taken off the saws by a revolving brush, and pass out through delivery rollers in the form of a lap.

Cottonize.—In textile manufactures, to reduce other fibers as hemp, flax, etc., to a short staple so that they can be worked up on cotton machinery.

Cotton Manufacture.—This comprises spinning the cotton into yarn, preparation of the yarn for the warp and weaving the yarn into a fabric.

Cotton Mule.—A spinning mule devised for cotton yarns; filling or weft is usually spun on a mule, as it makes softer threads than the throttle or ring frame.

Cotton Press.—One in which cotton is baled for transportation and storage. There are various forms of cotton presses,

known as the screw, toggle, beater, revolving, hydraulic, portable, double acting, windlass, rack and pinion, repressing, and rolling pressure presses.

Cotton Seed Oil.—The seed of the cotton plant is found in the pod among the down or wool. A useful oil is extracted from the husk or outer case of these seeds, ruby red at first, changing to a pale yellow on refining. This oil is used extensively in the manufacture of soap, candles, lubricating oils and margarine, and is largely employed as an adulterant for more valuable food products such as olive oil, butter, lard, etc. The specific gravity of the oil is .922 to .928 at 60° Fahr.

Cotton Spinning.—The spinning of cotton fibers in yarns, or threads; the process consisting essentially of a carding apparatus to comb out the fibers and lay them in parallel rows; whence from a loose fluffy rope the yarn is drawn down in successive stages, each giving a stronger pull and a tighter twist until it finally issues as a tightly rolled or twisted thread of uniform fibers.

Cotton Waste.—Refuse thread from the operations of spinning and weaving cotton, largely used in cleaning machinery, and also for packing axle boxes of railway cars.

Cotton Wool.—Cleaned raw cotton, used in manufactures and the arts; also in surgery.

Cottrel.—A hook and trammel for suspending a cooking vessel; as, a glue pot to keep the mixture always ready for use.

Couch.—1. In paper making, to take the flake of imperfectly compacted pulp from the mold or apron on which it has been formed. With hand laid paper this is the business of the *coucher*, who receives the mold from the *dipper* and couches the sheets upon a felt.

2. In malting, the heap of steeped barley on the floor where the grains undergo germination, effecting the change into malt. The operation of couching takes about fourteen days, and the subsequent kiln drying, which arrests germination takes two days.

Couchman.—In paper making, the man or worker whose duties are to couch the sheet upon a felt, after receiving the mold from the *dipper*.

Couch Roll.—In paper making, a pair of rolls which take the web or half dry paper from the wire and pass it on to the press rolls, giving it the first pressure to squeeze out the water. The under roll is usually a brass shell, while the upper is of brass or mahogany and covered with felt.

Coulisse.—1. In carpentry, a grooved piece of timber.

2. In civil engineering, a pair of battens, or a groove in which a sluice gate moves up and down.

Counter.—1. The overhang of a ship's stern.

2. A mechanism for registering or counting the revolutions or double strokes of an engine or pump. In an engine counter, water meter, or similar counter, whatever number of counter dials (or wheels) there may be, the right-hand always records 10; the next to the left 100; the 3rd, 1,000; the 4th, 10,000; the 5th, 100,000; and the 6th, 1,000,000. Hence, one having six dials can register 1,000,000 revolutions. When a counter has completed its full number of recording, all the numbers will show zero, to which must be added an imaginary one, making for seven dials or wheels, ten millions—and the next stroke of the engine will begin a new series with 1, etc.

Counterbalance.—In engineering, a weight placed opposite a crank arm to balance the revolving weights and a certain proportion of those having a reciprocating action. On stationary and marine engines, it is fixed on the opposite side of the crank, but the usual custom with locomotives is to dispose of it upon the wheels near the rim.

Counterbalancing Spring.—In locomotives, a spring acting on a plunger which tends to balance the weight of the link motion and facilitate easy reversal.

Counter Bore.—The enlargement of a round hole at either end; specifically the enlargement of a cylinder bore at each end of the barrel, to permit the easy entrance of the spring rings and also to permit the rings to travel the whole length of the bore and wear it equally, so that ridges are not formed at either end of the stroke. Also termed *bell mouth*ing.

Counter Brace.—In navigation, the brace of the fore topsail on the leeward side of a vessel.

2. In carpentry, a brace in a framed structure which resists a strain of a character opposite to that which a *main brace* is designed to receive.

Counter Clockwise.—Said of a mechanism, when it runs from right over to left, or contrary to the motion of the hands of a clock; also termed *left handed running* and *under running*; as, in a horizontal steam engine.

Counter Draught.—In ventilation, it is likely to occur in high buildings with a central hall, or stairway leading to the top, which will afford passage for a current, counter or antagonistic to the aspirating shaft. It is remedied by partitions checking the upward circulation.

Counterfeit.—Representing by imitation or likeness; having a resemblance to something else; fabricated in imitation of something else, with a view to defraud by passing the false copy for the genuine or original.

Counterfoil.—The part of a writing, as the *stub* of a bank check, in which are noted the main particulars contained in the corresponding part, which has been issued.

Counter Gauge.—An adjustable gauge, with double points for transferring measurements from one timber to another, as the breadth of a *mortise* to the place where the *tenon* is to be made.

Countermand.—To revoke a former command; to cancel or rescind by giving an order contrary to one previously given; as, to countermand an order for goods; to oppose; to forbid; to prohibit.

Counterpart.—A part corresponding to another part; anything which answers, or corresponds to another; a copy; a duplicate; a facsimile.

Counter Pressure.—A pressure which exerts an equal and opposite force to another; reaction of one pressure against another; *back pressure*.

Countershaft.—An intermediate or second motion shaft in a power transmission system; the overhead shaft of a machine tool, which is driven from the main shafting; the second motion shaft of an automobile, which is driven from the change speed gear and in turn drives the wheels by means of a chain or gearing.

Countersign.—To sign on the opposite side of an instrument or writing; to sign in addition to the signature of a principal or superior, in order to attest the authenticity of a writing.

Countersink.—A conical rose bit or fluted reamer, for enlarging bolt holes to a conical recess for the reception of the tapered head of the bolt, which is thus let into the material so that the bolt head is flush with the exterior surface.

Countersunk.—The conical recess or enlargement of a bolt or rivet hole made by a countersink.

Countersunk Nail.—In carpentry, a nail with a conical head like a wood-screw.

Counterweight.—A weight used to counterbalance; as, the counterweight on a locomotive driving wheel.

Counting Glass.—In linen manufacture, one of a series of magnifying glasses mounted in little frames with apertures of different sizes, cut to standard gauges. The counting glass is laid upon a linen fabric, and the number of threads which appear through any particular glass are counted, thus indicating the fineness of the material.

Counting Room.—The house or room in which a contractor, merchant or manufacturer keeps his books and transacts business.

Country.—A tract of land; a region; the place of one's birth, permanent residence or citizenship.

Country Rock.—In mining, the predominating rock in any workings, or that which surrounds the lode or vein.

Count Wheel.—The wheel in a clock which regulates the number of strokes.

Coup.—A sudden stroke; an unexpected device or stratagem; a term used in various ways to convey the idea of promptness and force.

Couple.—In mechanics, a pair of forces, equal, parallel and acting in opposite directions, the tendency of which is to cause rotation in the body acted upon.

Coupled Engine.—A locomotive having four or more driving wheels coupled together to increase available adhesion. The wheels so connected are termed *coupled wheels*.

Coupled Wheels.—In railway engineering, locomotive running wheels are coupled or connected with coupling rods, in order to ensure uniform running; that is, the weight necessary for adhesion is distributed equally between all the coupled wheels. They are called four, six or eight *coupled*, according as the wheels on two, three or four axles are thus united.

Coupler.—1. A contrivance that links together the various vehicles of a railway train.

2. The ring slipped by a blacksmith over the handles of his tongs to hold them together when grasping the work. Also known as *reins*.

Coupler Yoke.—In railway cars, a U shaped stirrup in a draw gear arrangement enclosing the springs and follower plates, and thus affording connection between the draw bar and the framing, through the follower plates.

Couplet.—The first term and the second term of a ratio together are called *couplets*.

Coupling.—1. An attachment whereby one piece of mechanism constrains another part to follow the movements of the first; it may be an absolutely rigid connection as a *flanged coupling* to unite sections of shafting together; flexible within limits, as a *universal joint* or a *diaphragm coupling*.

2. The coupler or link device connecting railway cars together.

3. A threaded socket uniting two lengths of pipe.

4. A *friction* or *jaw clutch* to connect and disengage moving parts with each other.

Coupling Bolt.—A bolt in a flanged coupling connection, generally used for line shafting.

Coupling Box.—In rolling mills, a loosely fitting coupling or *wobbler*, fitted half on the roll necks and half on the *breaking piece*, and prevented from moving too far either way by *stops*. By releasing the stops and sliding the coupling box to one side, a new breaking piece may be quickly substituted for the one that has given way.

Coupling Link.—1. In railway appliances, a link forming part of the chain used with screw couplings.

2. A temporary device carried on trains to connect cars, etc., when the automatic couplers are deranged, being fastened on each of the opposing draw heads with pins.

Coupling Rods.—In locomotives, horizontal rods or beams connecting the various driving wheels together, causing them to rotate in unison, and thus distributing the load over more than one pair of wheels.

Course.—1. In building, a single layer of bricks or stone blocks running around a structure.

2. In engineering, a ring or row of plates around a tank or gas holder; a *strake* of plating.

3. In navigation, the direction of a ship's path across the sea.

Coursed Rubble.—In masonry, work built of irregularly sized stones, trimmed and built up into regular courses. This is practically the same as that known as *broken ashlar*, the stones all bedding squarely and being built up so that each course is of uniform depth.

Course Metal.—An iron and copper matte containing sulphur; a product of copper smelting in a reverberatory furnace.

Courses.—In shipping, the largest and lowest squaresails.

Cove.—1. In navigation, a small sheltered inlet, creek, or bay: a recess in the shore.

2. A strip of prairie extending into woodland; also a recess in the side of a mountain.

3. In architecture, a concave molding; a member whose section is a concave curve, used especially with regard to an inner roof or ceiling; as, around a skylight.

Covenant.—A mutual agreement of two or more persons or parties, or one of the stipulations in such an agreement.

Cover.—1. Any thing used as a temporary clothing or protection.

2. A lid or door to any chamber or vessel which is not part of the latter, but may be removed when necessary on removing the nuts or bolts which secure it in place.

3. A lid, as of a pot or kettle.

Covered Way.—A passage from one building to another; as, between different parts of a railway station, etc., which is roofed over to protect those who traverse it, from the weather.

Covering Plate.—A butt or welt *strap* in a boiler, used to reinforce a butt joint between two plates, more especially in a longitudinal seam.

Covering Strip.—In iron work, the strip of metal plate which covers a butt riveted joint. Called also *welt* and *fish plate*.

Covers.—The lids or circular doors closing the ends of an engine cylinder. With engines of moderate and large size the cylinder cover nearest the crank sometimes forms a part of the cylinder barrel, the opening for the boring bar being closed by the stuffing box casting. With cylinders of seventy inches or more, it is customary to put in a manhole for inspection purposes. A similar manhole is also fitted to the removable cover in large cylinders, to avoid disturbing the joints. These covers, at either end, are usually termed *heads*.

Cowcatcher.—The protective framework fitted to the front ends of locomotives, for the purpose of pushing obstructions off the track. Its technical name is *pilot*.

Cowhide.—1. Leather made of the hide of a cow.

2. A coarse whip made of untanned leather.

Cowl.—1. A curved, flaring top fitted to a ventilator, which is turned in any direction. So called from a resemblance to a monk's hood or cowl.

2. Any top fitted to chimneys with the object of improving the draught, usually an apparatus of cones and deflectors.

Cow Mouthed Chisel.—A metal working chisel, shaped at the point like a carpenter's gouge. Its curved shape bears a fancied outline of a cow's upper jaw.

Cowper Stove.—In metallurgy, a regenerative stove in which the air supply for a blast furnace is heated by the waste gases. These gases pass through the Cowper stoves and impart their heat to the lattice work of fire brick with which they are filled, this heat being given up to the air blast which is then turned on; the stoves are worked in pairs, one being on *wind*, while the other is on *gas*. Also called *hot blast*, *blast furnace*, *regenerator*, etc.

C. P.—An abbreviation for candle power.

Crab.—A windlass or winch, operated by two or more men turning cranked handles, these turn the drum or barrel, upon which the chain or rope is wound, by means of spur gearing. A *crab* is usually fitted with a *pawl* to hold the load, and a *brake* to lower it. The name is also applied to a similar appliance driven by power, especially in connection with *traveling cranes*.

Crab Claw.—A detail in the valve gearing of certain steamers, connecting the main to the cutoff valve gearing, where poppet valves are employed.

Crab Claw Releasing Gear.—In *Corliss engines*, the original type of *trip gear*, fitted to valves which rotate towards the center of the cylinder. So named from the curved arm which effected the engagement between the valve and its driving mechanism.

Crack.—An incomplete separation of two parts of an object with or without a noticeable space between; a splitting.

Cracker.—In rubber manufacture, one of the deeply grooved iron cylinders which revolve in pairs and grind the

tough, raw caoutchouc, which has been previously cut in pieces by a circular knife.

Cracking.—In chemistry, the process of destructive distillation, or heating out of contact with air, in which most organic bodies undergo a complex decomposition, a number of fresh bodies being formed by a rearrangement of the atoms under the influence of the heat.

Cracking Still.—In petroleum refining, a still in which the process of destructive distillation is carried on; more properly, the distillation is *fractional*, the distilled products being continually diverted according to their specific gravity, so as to blend them into *benzine*, *burning oils*, *solar oil*, and *residue*; this last being variously treated according to the oil and the demands of the trade, sometimes being burnt for fuel, and at other places being distilled down to solid cake; lubricating oils, paraffin wax and many other products being first extracted.

Cradle.—1. In mining, a rocking apparatus, used in collecting gold from soil and sand by agitating the auriferous earth and water.

2. In shipbuilding, the frame in which a ship lies on the ways, and which accompanies her in launching.

3. In civil engineering, the frame in which a vessel lies in a canal lift. The cradle is floated under the ship and secured to it by cables, after which it is hauled over the incline planes by means of rollers.

4. In carpentry, the rough frame work or bracketing forming ribbing for vaulted ceilings and arches intended to be covered with plaster.

Cradling.—1. In cooperage, cutting a cask in two lengthwise, in order to allow it to pass through a doorway or hatchway, the parts being afterwards united and rehooped.

2. In carpentry, the framework in arched or coved ceilings to which the laths are nailed.

Craft.—1. Skill or ingenuity in any calling, especially in a manual employment; an occupation or employment.

2. In navigation, a term applied to small ships.

Crag.—1. A steep, rugged rock; a rough, broken rock, or point of a rock.

2. A geologic formation, consisting chiefly of shelly sands and gravels.

Cramp.—1. To hold tightly; press together; to restrain from free action; to confine and contract.

2. In building, a bar of iron with its ends bent at right angles, used for fastening large stones to each other in masonry; the *cramps* are retained in their sockets by cement or molten lead poured around them.

3. In engineering, wood working, etc., a tool by means of which sustained pressure can be applied to work; as, for holding different pieces together or for fixing a part while being operated upon. The usual form resembles three sides of a rectangle or the letter G, pressure being usually applied by means of a screw.

Crampoon.—1. A hooked piece of iron, something like double calipers, for raising stones, lumber, and other heavy materials; also called *crampon*.

2. An iron attached to the foot for walking on ice, or climbing telegraph poles, etc.

Crane.—In machinery, a machine for hoisting and lowering heavy weights. It consists of a vertical post or frame, which is rotatable on its axis, and a jib or projecting arm over which the chain or rope passes on its way from the winch at the foot of the post to the load to be lifted. Cranes are arranged to be operated by hand, steam, hydraulic power or electricity; they may also be operated by means of endless ropes or shafting and worm gearing from another source of power.

Crane Necked.—A term applied to the frames of certain steam fire engines, on account of the curvature of the forward portion, resembling a crane's neck.

Crane Spout.—A swiveling spout fitted to the head of a grain elevator, for purposes of distribution into bins.

Crane Way.—In engineering, that part of an erecting shop which is left free for the operation of a hoist or a traveling crane.

Crank.—1. In mechanics, a lever formed at right angles to a shaft or keyed thereto, by means of which the shaft may be turned or the motion of the shaft be imparted to another mechanism. The crank is the common device for converting reciprocating motion into rotary; as, in the ordinary direct acting engine.

2. In shipping, possessing unstable equilibrium; as, a vessel after discharge of cargo or ballast, or one that cannot stand up stiffly under her canvas through defect in her modeling. Usually termed *cranky*.

Crank Axle.—In locomotives, the main driving axle used in connection with inside cylinders, the *crank throws* being formed in it either by bending a round bar, or by machining it out of a solid forging.

Crank Case.—In engineering, the casing surrounding the moving parts of a small engine, protecting them against dust and damage, and acting as part of the framing in supporting the cylinders.

Crank Chamber.—The enclosed space of a small high speed engine or of an internal combustion motor; usually made water tight, so that there may be carried oil or oil and water up to the shaft level, in which the cranks dip at every revolution, splashing the lubricant over the moving parts. When no fluid is contained in the chamber, it is generally termed a *crank case*.

Crank Disc.—In steam engines, etc., an arrangement whereby the *crank webs* or arms are replaced by circular discs to facilitate balancing.

Cranked.—A term applied to tools or machinery parts bent in some special way. A tool may have two abrupt bends formed in it causing the point to be parallel with the main axis but to one side; other tools may have a curvature or *swan's neck* formed behind the cutting edge, permitting a certain amount of spring.

Crank Eye.—The small boss in the web of an over hung or side hitch crank; the portion of a crank arm or web bored for the reception of the crank or wrist pin.

Crank Hub.—The large boss in the web of an over hung or side hitch crank; the portion of a crank arm or web which is bored to fit the shaft.

Cranking.—In motor cars, the act of rotating the motor, by means of a handle, in order to start it. Turning it over a few times causes the engine to take up its cycle, and after an explosion it continues at work.

Crank Path.—In mechanical engineering, the circle described by the pin or movable journal which unites the connecting rod of an engine or pump with the crank.

Crank Pin.—The cylindrical stud or pin at the extremity of a crank, opposite to the shaft and parallel with it, which affords attachment for the link or connecting rod by which the crank shaft is turned.

Crank Race.—The chamber, hollow or trough in which the crank of an engine revolves. This term is usually applied to *horizontal engines*; on vertical machinery it is designated *crank pit*.

Crank Shaft.—The main shaft of an engine in which are formed the cranks for converting the reciprocating motion of the pistons into the rotary motion of the shafting. There are great varieties of forms, depending upon the type of engine. Small sizes are frequently bent from circular bars or

machined out of the solid, but shafts of even moderate dimensions are usually made in sections bolted together, the sections composed in turn of parts shrunk and keyed together. This eliminates risk in heavy forgings, and facilitates repairs.

Crank Shaft Bracket.—In cycles, the bracket fixed to the frame of a bicycle to support the crank shaft.

Crank Shaper.—A shaping machine driven by a wrist pin, set in a slotted lever, or fixed as a crank in the side of a revolving disc, the travel of the ram being shortened in each case by moving the wrist pin nearer the center of vibration or rotation, and lengthened by moving it further out.

Crank Sprocket.—In cycles the sprocket or toothed wheel, on the crank of a bicycle, which drives the chain.

Crank Sweep.—1. The throw or distance equal to the diameter of the circle described by the center of the crank pin.

2. The circular path traced by a revolving crank pin.

Crank Web.—In machinery, the central plated portion of an ordinary cast iron crank, which contains the bosses and is stiffened with a rib or ribs.

Crash.—Coarse linen cloth used for toweling.

Crate.—A rectangular basket made of rough sticks or battens or of wickerwork with wooden supports. It is used for the transport of more or less fragile articles, generally packed in straw.

Crater.—1. A large two handled vase or cup, in which the ancients mixed water and wine.

2. In geography, the cup or funnel shaped cavity forming the mouth of a volcano.

Crayon.—A pencil made of white or colored chalks, used for marking on metals, for writing on a blackboard or executing pastel pictures.

Crawl.—To move slowly by drawing the body along the ground, as a worm; to move slowly on hands and knees, to creep.

Creak.—To make a prolonged sharp grating or squeaking sound, as by friction of hard substances; as, doors upon their hinges *creak*.

Creaking.—In tinsmith's work, the peculiar sound emitted by a bar of tin when bent alternately backwards and forwards.

Creamer.—In dairy machinery, a centrifugal cream separator.

Cream of Tartar.—In chemistry, potassium bitartrate, a white crystalline compound made by purifying argol. It is used in making *black flux* for blow pipe work, in dyeing, and in baking powder.

Cream Separator.—A centrifugal extractor, consisting of a bowl rotated rapidly in a horizontal plane, used to separate cream from milk by mechanical means. When a liquid is whirled around in a similar receptacle, the components arrange themselves in distinct cylindrical strata within the *basket* or bowl, the lighter going to the top. Ducts are provided to carry each constituent away separately, while the raw milk is fed into the center of the basket by a vertical axial tube, the separation into layers being facilitated by discs within the bowl.

Crease.—A line or mark made by folding or doubling any pliable substance; hence, a similar *mark* however produced.

Creasing Tool.—In copper and white-smithing, a stake or T shaped iron with small grooves across one *beak* or horizontal arm. It serves to bend sheet metals, by hammering to form small tubes, beads and the like.

Create.—To bring into being; to cause to exist; to produce; to form or fashion; to renew.

Credit.—Trust given or received; expectation of future payment for property transferred; or of fulfillment of promises given; mercantile reputation entitling one to be trusted, applied to individuals or corporations.

Creel.—In spinning, the bar which holds the paying off bobbins in the bobbin and fly, the throstle machine or the mule. In the first machine the bobbins hold the sliver, which is to be spun and twisted into a roving, in the latter machines by a substantially similar operation, the roving is converted into yarn. The creel may have several bars with rows of skewers, upon which the bobbins are placed to unwind their contents.

Creep.—A movement of one part of a structure relative to those parts with which it is in contact; as, for instance, a slipping motion between a belt and the drum or pulley upon which it revolves.

Creeper.—An instrument, in form like a four clawed grapnel, used to drag the

bottom of a harbor or river in search for anything lost.

Creeper Box.—A spiral conveyor in a flour mill; more properly, the case around the conveyor, the spiral itself being the *creeper*.

Creeping Sheet.—In textile manufactures, the traveling apron or endless band which feeds a cording machine.

Creeps.—In mining, a movement which occurs where there is a soft floor and a hard roof, the weight of the mass overhead forcing the floor up into waves as the supporting pillars are removed.

Cremation.—The disposal of human remains by means of fire. The body, in an asbestos shroud, is placed upon an iron trolley, which is run into the hearth of a *reverberatory furnace*. This is previously heated to a temperature of about 1800° F., and is constructed so as to burn all gases. The time occupied in reducing the remains to ashes, may be stated as thirty to forty minutes.

Crenellation.—In architecture, the act or process of indenting molding, as used in large galvanized iron cornices for building in the Norman style.

Creosote.—An oily liquid with a characteristic smoky smell obtained by distillation from that portion of wood tar (principally beechwood), which distills between 400° and 425°, or that portion of *coal tar* which distills between 450° and 510°. Wood creosote is colorless, that from coal tar is greenish. It is used for *pickling wood* to preserve it, and as a disinfectant.

Creosoting.—The process of impregnating timber, especially railway sleepers, with creosote as a preservative, also known as *cyanizing*. The kiln or creosoter is a circular tube perhaps 100 feet long, into which four-wheeled trucks are run, these being loaded with the sleepers so as to correspond with the cross-section of the kiln. The door is sealed when full, external steam heat applied, and an exhausting air pump set in motion to draw all air and moisture from the pores of the wood and the interior of the kiln. When a sufficiently high vacuum is attained, boiling creosote is forced into the kiln until a pressure of 15 to 25 lbs. per sq. inch is reached, the pressure being maintained until the timber can absorb no more. The superfluous creosote is then run off, the door opened, and the cars hauled out; the sleepers being stacked in the stock yards by overhead transporters.

Creosoting Cylinder.—In timber preservation, a strong wrought iron cylinder in which railway timbers, sleepers, etc., are exhausted of their moisture in *vacuo*, and afterwards saturated with creosote pumped in under pressure.

Crescent.—Anything having the shape of a crescent or new moon.

Cress.—In smithing, to reduce by drawing down, as the end of a pipe. The heated end is *creased* around by means of a *creasing fuller* which forms a furrow of the right diameter, the projecting part is drawn down by means of half round *swages*, and the end *trimmed*. By extension, a cress is a reduction in diameter in any pipe, whether cast or wrought.

Cresset.—1. In cooperage, a small furnace or iron cage to hold fire for charring the inside of a cask and making the staves flexible.

2. An open frame or basket of iron, filled with combustible material, to be burned as a beacon; an open lamp or firepan.

Crest.—1. In architecture, the ridge of a roof; hence, *crest tiles*, which lie on the comb of the roof and shed water both ways.

2. In civil engineering, the top of a parapet, embankment, slope or wall.

Crest Tiles.—A saddle tile, one having a double slope, on the ridge of a roof.

Cretaceous.—In geology, appertaining to or resembling *chalk*; the *cretaceous system* is the uppermost of the secondary rocks, the chalk being its most conspicuous member.

Crevasse.—1. A deep fissure; as, in an embankment; one of the ice clefts or fissures by which the mass of a glacier is divided.

2. A breach in the *levee* or embankment of a river, caused by the pressure of the water; as on the lower Mississippi.

Crew.—1. In navigation, the company belonging to or manning a ship.

2. In railway engineering, the men forming the gang which run a wrecking car or a train.

3. In construction work, the men working on a derrick, pile driver, steam dredging machine, etc.

Crib.—1. In civil engineering, a timber construction filled with rubble stone.

2. To line a shaft or well with timber framing or cribwork.

Cribwork.—In construction work, a series of layers of logs laid alternately lengthwise and crosswise, secured to each other at their intersections by notching, pinning, etc.

This is used to line pits, shafts, etc., and also in land reclamation work and bridge building in swift shallow currents. In the latter case, the cribs are built to a convenient size and floated into position, anchored by being filled with rubble and further secured by driven piles on their outer faces. The cribs thus afford a curb, or retaining wall and protection for earth work or masonry behind them.

Crick.—In house shoring and moving, a small *jack screw*, mostly used in underpinning.

Cringle.—In navigation, a rope made into a grommet and containing a thimble and worked into the bolt rope of a sail for the attachment of a bridle or rope. The head cringle is lashed by the head gearing to the straps on the yard arm. The singles on the *leech* are for the attachment of the reef tackle.

Crinkle.—To form with short turns, bends, or wrinkles; to mold into inequalities; to cause to wrinkle or curl.

Cripple Timber.—In carpentry, studding or scantling used in narrowing situations, where they are necessarily shorter than their fellows, as the cripple studding from the rafters to the floor, joists in attics finished with a collar beam ceiling. A *jack timber*.

Cris-cross.—1. To mark or cover with cross lines; as, paper was *cris-crossed* with red marks.

2. In opposite directions; in a way to cross something else; crossing one another at various angles and in various ways.

Crisis.—The point of time when it is to be decided whether any affair or course of action must go on, or be modified or terminate; the decisive moment; the turning point.

Crisp.—Friable; in a condition to break with a short, sharp fracture; to possess a certain degree of freshness; in a fresh unwilted condition.

Crisper.—In manufacture, an instrument for crisping the nap of cloth; i.e., covering the surface with little curls, such as with petersham or chinchilla. A *crisping iron*.

Critic.—One skilled in judging of the merits of finished work; an adept.

Critical Pressure.—In physics, the pressure causing the liquefaction of a gas, at or about its *critical temperature*.

Critical Temperature.—In physics, the temperature at which a given substance begins to change its state; as, from a solid to a liquid or *vice versa*. The critical temperature of gases is one above which it is impossible to liquefy them. The volume at this point is termed the *critical volume*, and this, together with the temperature, and the necessary pressure to produce liquefaction, are sometimes termed *critical data*.

Crochet File.—A small file for fine work, tapering in form, with two flat sides, and rounded edges, cut throughout.

Crock.—1. The loose black particles collected from combustion, as on pots, and kettles, or in a chimney; soot; smut; also coloring matter which rubs off from cloth.

2. A piece of crockery, especially of coarse earthenware.

Crockery.—In pottery, a term, as far as it may have a less general meaning, includes merely the commoner class of the potters' products and defines a sort which, more than any other, is used in the industrial arts and manufactures.

Crocodile.—In tools, the name of a reptile after which several tools are named on account of their peculiar shape of prongs, formed like the mouth of a crocodile.

Crocodile Jaws.—In metallurgy, a machine for shingling puddled iron, known also as a *squeezer*; in which the bloom is subjected to pressure between massive serrated jaws, worked by a cam or toggle joint. Also called *alligator squeezer*.

Crocus.—A preparation of ferric oxide, forming a fine red powder used in polishing. Also called *red oxide of iron*.

Crofting.—In manufacture, exposing linen on the grass to the influence of air and sunshine, after being *bucked* or soaked in an alkaline lye in the bleaching process.

Crompton, Samuel.—Born 1753, died 1827. An English inventor. Compelled at an early age to devote himself to spinning and weaving for support, he was led by his exasperation at the imperfections of Hargreave's spinning jenny, to devise a spinning machine of his own. Devoting almost constant night work to this project, for a period of five years, he completed in 1779, the so called "spinning-mule," which proved to be a distinct advance over any previous spinning machine. Not having the means to secure a patent, he unwisely gave his invention to the public in

exchange for promises that proved to be worthless. His only reward, after a long period of disappointment, was a government grant of £5000, although his invention had revolutionized the cotton weaving industry.

Crook.—1. Any implement having a bent or crooked end.

2. To bend; to curve; to wind; to have a curvature.

Crook Bit Tongs.—In blacksmithing, a pair of tongs with the lips bent at right angles to the jaws, thus permitting the grasping of a long bar or piece which lies parallel to the tongs. A snub or bit is generally formed to prevent the work slipping.

Crookes's Tubes.—A vacuum tube, in which the exhaustion is carried to a very high degree, with the production of a distinct class of effects.

Crop.—In tanning, an entire untrimmed hide, struck for sole leather; generally ox hides tanned whole with oak bark.

Crop End.—The excess material sheared from the end of a bar or bolt in the process of cropping to length.

Cropping.—The act or process of shearing off materials to a desired length; as, with bolts and rails; and shearing bars to uniform lengths for *piling* or *fagoting*.

Cross.—1. A line drawn across another line.

2. In civil engineering, a surveying instrument for laying off offsets, perpendicular to the main course.

3. In mechanics, a pipe fitting with four branches, the axis of which usually forms a right angle.

4. In moulding, a four armed bar of iron used to sling heavy foundry boxes, etc., when manipulated under the crane, the boxes being supported by links from each arm.

Cross Axle.—1. In machinery, a shaft-windlass, or roller worked by opposite levers; as, a copper plate printing press.

2. In railroad engineering, a driving axle with cranks set at an angle of 90° with each other.

Cross Bar.—1. In civil engineering, a transverse bar used in any structure.

2. In railway engineering, the bar that supports the casting carrying the spring plank of a railroad car.

3. In navigation, the bar at right angles to the shank of an anchor.

4. In ordnance, a bar in a breech loading gun which presses out the extractor when the barrel falls.

Cross Bending Strain.—The strain acting in a transverse direction on horizontal engine beds, pump beds and base plates, due to the thrusts of the rods. To reduce this to a minimum, the centers of the cylinders and rods are kept as low down as possible, lessening the leverage thereby.

Cross Bond.—In masonry, a form of bricklaying, in which the joints of one stretcher course come midway between those of the stretcher courses above and below; a course of *headers* and *stretchers* intervening.

Cross Compound.—In engineering, a term applied to a design of compound stationary engine, in which the high and low pressure cylinders form distinct and separate engines, each upon its own bed, with the fly wheel between them, the cranks being usually overhung. This type of engine is very accessible in all its parts, and the main bearings are easily kept in line.

Cross Cut.—In mining, a horizontal gallery, not following the veins as does a *drift*, but transverse to them, in order to connect different workings.

Cross Cut Chisel.—In tools, a cold or chipping chisel whose cutting edge is across the tapering point, being narrow or about $\frac{3}{8}$ inch wide. This tool is used for cutting keyways, etc., but more especially for cutting grooves in various directions across a surface, in order to facilitate subsequent chipping with the ordinary flat chisel. Also termed *cape chisel*.

Cross Cut Saw.—1. A hand saw, whose teeth are fashioned with two beveled edges, thus cutting equally well in either direction and suitable for sawing *across the grain* of the wood.

2. A large saw with similar teeth to the above, useful for sawing across logs, beams and the like, being generally operated by two men, one on either side of the piece of timber.

Crossed Arm Governor.—In engineering, a centrifugal governor whose arms are *crossed*; that is, the point of suspension is on the opposite side of the spindle to the weight. This causes the balls to vibrate in a parabolic path, ensuring more sensitive governing.

Crossed Belt.—One employed to drive a pulley in the opposite direction to its driver. The part of the belt going from the top of one pulley to the bottom of the other is turned half round so that the same belt face shall be in contact with each pulley, and that the two parts shall be edgewise where they pass each other. With a crossed belt *speed cones* may be of straight taper, and the

belt will fit equally tight upon any two drums in a *stepped cone* provided the sum of the two diameters remains constant.

Crossed Rods.—In a steam engine, if the eccentric rods cross each other, while the crank throw is turned away from the link, or the sheave centers are between the shaft center and the link, the rods are said to be *crossed*. If the reverse obtains, they are termed *open*. When it is intended to work the engines linked-up, as with a locomotive, it is advisable to have the rods open, as a greater range of expansion is obtainable with less reduction of port opening than with crossed rods.

Cross Feed.—In a turning lathe, the motion of the tool across the bed, at right angles to the axis of the work; the slide and gear connected therewith for giving this motion. Use of the cross-feed is generally termed *surfacing*.

Cross Filing.—In engineering, etc., the process of filing a surface upon a piece of metal, the stroke of the file being made at right angles to the vise jaws or nearly so, or across the work. The opposite of *draw filing*.

Cross Girder.—In architecture and mechanical designing, any beam which unites longitudinal girders, side frames or standards together, and becomes at the same time a distance piece, stretcher or strengthening beam, or the support or base for machinery. Examples occur in the cross or central girders of steam cranes.

Cross Grained.—In timber, having the grain or fibers crossed or intertwined.

Cross Hatching.—In mechanical drawing and engraving, the use of shade or section lines crossing each other, to indicate materials, tinctures, or the effects of light and shade. Usually called *section lining*.

Crosshead.—In engineering, the connection between the piston and connecting rods of a reciprocating engine. With marine engines of moderate size and many small motors, it is sometimes an enlargement of the piston rod. In stationary and locomotive work, it is usually a separate steel casting, having a taper socket into which the piston rod is cotted, with a separate pin through the jaws of a double-eye to serve as a gudgeon on which the connecting rod vibrates. In large marine engines, it is a steel block into which the piston rod is bolted, a projecting arm on either side affording attachment for the forked end of the connecting rod.

Crosshead Gib.—An adjustable bearing surface, let into the crosshead of an engine and usually made of brass to reduce friction.

Crosshead Gudgeon.—With solid end connecting rods, the pin, shrunk into the fork, and held by the bearing in the split piston rod end. With split end connecting rods, the *gudgeons* are the projecting ends of the steel crosshead. When the gudgeon is detachable from the crosshead or connecting rod, it is termed a *crosshead pin*.

Crossing.—In railways, the point at which the curve of a switch crosses the line from which it turns out; the place of intersection of two railway tracks. In either case, the *crossing* consists of a gap in the rails, to permit the flanges of wheels on the other line to cross it.

Crossing File.—A small taper file having two unequal convex sides, like a fish belly file; used by die sinkers, tool and instrument makers to trim the arms of small wheels, etc. Also known as *cross file*.

Cross Key.—A part of the friction gear of a hoisting engine. It is inserted in a slot on the drum shaft and communicates motion from the friction pin to the cross key cellar.

Cross Key Collar.—A part of the friction gear of a hoisting engine, on the drum shaft between the cross key and drum head. It communicates lateral motion from the cross key to the drum.

Cross Rail.—The horizontal member of a planing machine or boring mill, which spans the distance between the uprights and carries the tool boxes; it is adjustable vertically to suit the height of the piece operated upon.

Cross Section.—In drawing, a transverse view of a structure or mechanism, showing the various parts in section; the view is usually taken on a line at right angles to the length.

Cross Shed.—In weaving, the upper shed of a gauge loom.

Cross Tail.—In engineering, a part fulfilling the functions of a *crosshead*, but at the other end of the piston rod. In large horizontal engines, the cross tail supports the end of the tail rod and affords attachment for links or a bell crank whereby the vertical air pump may be driven. In side lever engines, the cross tail is the bar connecting the two ends of the beams remote from the cylinder and which serves as a wrist pin for the connecting rod end.

Cross Tie.—1. In railways, a *sleeper* connecting and supporting the two parallel rails.

2. On a locomotive, a transverse member of the bar framing, denominated according to its position in reference to the cylinders, pedestals, firebox, etc.

Cross Trees.—In shipping, the horizontal arms at the junction of the top and lower masts in fore and aft rigs, and at the top mast head in square riggers; used to extend the top and top gallant rigging and stay those masts.

Cross Tube.—In boiler making, a coned or Galloway water tube placed transversely across a firebox or furnace flue to increase the heating surface and improve the circulation.

Cross Valve.—A valve fitted on a transverse pipe so as to open communication at will between two parallel lines of piping. Much used in connection with oil and water pumping arrangements, especially on ship board.

Crotch.—1. An angle formed by the intersection of two legs or branches; a fork.

2. An upright stanchion with a forked head, resembling two horns or a half moon, for supporting a spar or boom when it is not in use; especially the ends of a *derrick*.

Crowbar.—An iron bar, usually with a curved chisel point at one end, used as a lever or *pinch bar* for handling heavy articles, etc.

Crowfoot.—In navigation, a circular wooden block perforated with holes, through which are rove lines supporting an awning at the center, thus obviating a central strut or ridge pole. Much the same as *euphroe* or *uphroe*.

Crowfoot Brace.—In steam engineering, a Y shaped brace or forked stay fitted in certain boilers, the fork being used to clear a nut or fitting on the boiler end.

Crown.—1. The higher part of any structure or thing with curved outline; as, the central part of a roadway, the summit of a hill, etc.

2. In building, the highest part of an arch or arched structure.

3. In boilers, the highest part or roof of a firebox, furnace, flue or combustion chamber, etc.

Crown Bar.—In a locomotive, a girder or bridge stay for the crown of the firebox. In American practice, the crown

bars are placed transversely and are slung from the outer fire box shell; in English locomotives, where fitted, they are placed longitudinally and supported from the tube and back plates. Also called *roof bar*.

Crown Cutter.—In mining, a boring tool in which the cutting points are arranged at right angles and circumferentially, like the points or spikes of a crown.

Crowned Pulley.—A pulley that is made rounding across its face, as distinguished from a cylindrical *drum*, or a pulley in which the belt is retained by flanges.

Crown Glass.—Window glass made by blowing a bulb which is burst at the end, and *flashed* or expanded into a disc or *table* by rotary motion in a flashing furnace. Crown glass is more brilliant than ordinary sheet glass, but is irregular in thickness, and much waste is occasioned by the bullseye in the center where it was attached to the blowing tube or to the *pontil* for rotating it.

Crowning.—1. In civil engineering, the curvature given to the surface of a road way, permitting water to run off on either side.

2. In mechanics, the convexity given to the middle of a pulley rim, thus keeping the belt in place and also permitting the latter to lie in a more natural position, while improving the *adhesion*.

Crown Sheet.—In a locomotive boiler, the upper plate of the internal fire box, forming its roof.

Crown Stays.—In a locomotive boiler, those stays supporting the roof or upper surface of the internal fire box.

Crown Wheel.—In mechanics, a wheel with teeth or cogs, set at right angles to its circumference instead of radially, as in spur gearing. Called also a *face wheel*. Crown wheels are much used in watch making.

Crow's Feet.—The arrow heads, or < > marks, at the end of dimension lines on a mechanical drawing.

Crow's Foot Spanner.—A spanner or wrench, in which the *jaws* are set at right angles to the *shank*, thus making an effective tool for removing or tightening nuts in restricted places, as in the valve chamber of a vertical engine.

Crow's Nest.—In shipping, a lookout platform with wind screen rigged on the topmast of a ship; a regular *lookout station* on fast passenger steamers.

Croze.—In cask making, a moulding plane used by a cooper to *gullet out* the groove in the staves of a barrel for the reception of the heads; the groove itself in which the head of a barrel is held.

Crozing Machine.—A machine used in cooperage, which crozes casks placed in a sort of cradle and held by rings or hoops abutting on either end. Internal cutters scoop out the groove or *croze*, and the semi-circular hollow known as the *howel*.

Crucial.—Having the form of a cross, as a guide post; intersecting.

Crucible.—1. A pot made of clay, plumbago or other refractory material, in which metals or alloys are melted.

2. The lowest part of a blast furnace, below the *hearth*, within which the molten metal collects. Its floor is known as the *sole*.

Crucible Steel.—A homogeneous steel, obtained by melting pieces of suitable blister steel in covered crucibles of plumbago and fire clay; the crucibles are arranged in sixes or twelves in a reverberatory furnace. Several crucibles are poured simultaneously by well drilled workmen, to secure uniformity. This steel is more homogeneous than *shear steel* and possesses greater tenacity, with a fine granular structure. By the addition of manganese carbonate the property of weldability is restored to crucible steel and brittleness is corrected.

Crucible Tongs.—Tongs with large semi-circular jaws, used to lift crucibles in or out of the furnace.

Crude.—In its natural state; not prepared by fire or heat; not altered, refined or prepared for use by any artificial process.

Crude Liquor.—Ammoniacal liquor from gas works or blast furnaces in its raw state, preparatory to treatment for ammonia recovery.

Crude Oil.—Petroleum as it issues from the ground; unrefined oil.

Cruise.—A voyage made in various directions; as, of an armed vessel for the protection of other vessels, or sailing to and fro; as, for exploration or pleasure.

Cruiue.—A salmon trap of the nature of a weir. It has stone walls, which cross the river and an intermediate chamber of slats or spars which admits the fish but stops their exit.

Crumble.—To break into small pieces; to cause to fall to pieces; as, a *crumbling wall*.

Crup Butt.—In leather, a portion of a horse hide cut from the crupper. It is nearer waterproof than other portions and from its greasy soft nature is especially suitable for *wading boots*; such as are used in hydraulic work.

Crusher.—A mill or machine for mashing rock or ore, largely used in mining and construction enterprises.

Crushing Strain.—One occasioned in a material by simple compression; as, by pressure on a column in the direction of its length.

Crushing Strength.—The ability of any material to resist strains due to compressive stresses. Generally speaking, a body which exhibits great resistance to crushing is deficient in tensile strength; as, cast iron or concrete.

Crutch.—1. In shipbuilding, one of the struts or stay plates in the prow or stern of an iron vessel, which support the sides where they nearly approach each other. They occupy a position corresponding to that of the dead wood in a timber vessel, and are used to prevent the crushing in of the plating.
2. The cross handle on the end of a founder's metal ladle by which it is tipped.

Crutcher.—In soap manufacture, a wooden plunger used to agitate soap in the cooling frames, replaced in large factories by an Archimedean screw. Agitation or crutching prevents the dissociation of soap into two liquids and assists the incorporation of the various *filling materials*.

Crutch Handle.—In tool making, the cross handle fitted to a spade or shovel, as distinguished from the D shape, also extensively employed.

Cruz.—1. In navigation, the Southern Cross, the most celebrated constellation of the southern heavens.
2. In mechanics, anything that puzzles or vexes in a high degree.

Cry.—To make a loud call or cry; to call or exclaim vehemently or earnestly; to shout; to proclaim; to implore.

Cryolite.—A double fluoride of aluminum and sodium, which forms one of the sources of aluminum. It is a white, scaly mineral, with a regular cleavage.

Crypto Gear.—A change speed gear for automobiles, resembling *sun and planet* motion. Also called *planetary gear*.

Crystal.—1. The term applied to all symmetrical solid shapes assumed spontaneously by lifeless matter.

2. Clear, pellucid and transparent, like ice.

3. Silica or quartz, in a transparent form; so called because the ancient Greeks believed the gem to be a manifestation of ice.

4. Fine flint or *crystal glass*, consisting of lead and potassium silicates, possessing great luster and transparency, and suitable for optical purposes.

Crystallization.—1. The formation of substances as symmetrical solids or crystals, which are definite geometrical figures bounded by flat surfaces. To the chemist and mineralogist the form and appearance of the crystal are generally sure indications of its constitution.

2. The arrangement of the molecules of a fluid substance or liquid into crystalline bodies on cooling or through thickening by evaporation, as with saline solutions.

3. The rearrangement of the molecules of a metal into crystalline structure under alterations of stress or overload, as with a crane chain or a steel rail.

Crystallization of Iron.—In physics, this is affected by the conditions under which it is cooled. If cooled rapidly against a cold metallic surface it becomes chilled, and the crystals are long and needle-like. If cooled slowly the crystals are large and the grain is coarse. Crystals which are near the surface always arrange themselves at right angles to the surface. Crystals near the surface are always smaller than those nearer the central portions. The crystals of graphite mingled among those of the iron are also affected by the conditions of cooling, remaining uncombined in metal cooled slowly, but entering into chemical combination when cooled rapidly.

Crystallography.—A mode of ornamenting glassware by taking impressions from intaglio and impressing them on the ware while casting.

C Spring.—In carriage building, a spring in form like the letter C, and employed in vehicles. It is planted on the frame of the carriage and to its upper pliable end the *suspension straps* are fastened.

Cubature.—The act or process of discovering the volume or contents of anything; *stereometry*; *cubic measure*.

Cube.—A rectangular solid, measuring the same lineally in the three directions of length, breadth and thickness. Its contents are equal to the product of the lineal measurement of each dimension, hence the *third power* of a number is termed its *cube*, as it represents the product of three factors each equal to the stated number. This is written a^3 or a *cubed*, as it equals $a \times a \times a$ or $a \times a \times a$.

Cube Root.—The number or quantity which multiplied by itself two times produces a certain *cube*; thus, 3 is the cube root of 27, for $3 \times 3 = 9$, and $9 \times 3 = 27$.

Cubical Expansion.—The increase in volume of a substance under the influence of heat, or diminution of pressure.

Cubic Foot.—The volume contained within a space one foot long, one foot broad and one foot deep; 12^3 or 1728 cubic inches, and $\frac{1}{8}$ or $\frac{1}{27}$ of a cubic yard. The usual *unit of capacity* in dealing with fluids or liquids, except for purposes of buying and selling, when either weights or gallons are employed.

Cubic Yard.—The customary unit for measuring excavations, embankments, and also concreting and masonry. It is an equivalent volume to that of a six-sided figure or cube, each edge of which measures one yard or three feet.

Cubit.—An ancient measure of length, equalling 18 inches; supposed to be the length of the fore arm, as the yard was that of the arm.

Cucurbit.—In chemistry, the body of a still or retort; the belly or lower part of the old fashioned *alembic*.

Cuddy.—In shipping, a small cabin; the cabin in a small craft.

Cuff.—To strike; especially, a blow with the open hand; a slap.

Cugnot, Nicolas Joseph.—Born 1725, died 1804. A French engineer. He began his career in Germany, but, in 1763, went to Paris where he devoted himself to giving lessons in military science, inventing at that time a type of gun which met with a measure of success. In 1769 he undertook to build a carriage propelled by steam, and was encouraged by his attempt to construct, soon after, a steam coach of considerable size. This coach, though cumbersome and unmanageable, pointed the way to the possibilities of the self-propelled vehicle and is still preserved, in Paris, as a curiosity of automobile history. Cugnot left several published works chiefly concerned with the art of war, but he will be remembered as a pioneer builder of the motor car.

Cul-de-sac.—An alley or street which has no outlet at one end; a way or passage that leads nowhere.

Cull.—To separate, select, or pick out.

Cullet.—In glass making, broken window glass or debris from its manufacture; used as a flux to separate excess saline

matters from the molten metal in the form of *sandiver* or *slag*.

Culls.—In carpentry, refuse timber or other material from which the best part has been *culled* out.

Culm.—A name applied to various classes of coal, originally a Devonshire name for an impure form of coal found locally. Elsewhere it means, (a) slack coal; (b) breeze, as used in brick burning; (c) waste coal, mixed with slate or rubbish; (d) the dust or refuse of Pennsylvania anthracite, or the same when found in an impure or pulverulent state.

Culm Bed.—In mining, a heap, dump or tippie for anthracite *slack* or *culm*.

Cultivate.—To improve by labor, care or study; to impart culture; to refine.

Cultivation.—The art or practice of cultivating; production by tillage; bestowal of time or attention for self improvement or benefit of others; the state of being cultivated; advancement in physical, intellectual, or moral condition; refinement.

Cultivator.—A term applied to two types of agricultural implements; (a) properly, to ploughs, hoeing and raking machines, which are used to loosen the ground, destroy weeds between rows of plants, and to bank up earth against the stalks, as with Indian corn, etc.; (b) to steam diggers or similar implements in which the soil is broken up and turned over by a series of spades.

Culvert.—In civil engineering, an arched masonry drain for the passage of water under a road or railway, etc.

Cumulative.—Composed of parts in a heap; forming a mass; aggregated; augmenting; gaining, or giving force, by successive additions.

Cup.—A term largely applied to many mechanical details which present a resemblance to a drinking cup, either in form or in use; especially:

1. In lubrication, a vessel or small funnel for receiving oil, etc., and conveying it to a machinery part, an oil cup.

2. In grain elevators, a bucket or receptacle with a more or less curved outline.

3. In well boring, the removable lower part of a sand pump or bailer, containing the non-return valve.

4. In automobiles, cycles, etc., a cup shaped ball race for certain ball bearings.

Cup and Ball Joint.—In gas fitting, a ball and socket joint fitted to hanging gas chandeliers. It allows the chandelier to turn freely without escape of gas.

Cup Board.—A closet or cabinet fitted with shelves for the reception of plates, cups and other table articles; formerly a species of sideboard upon which gold and silver tableware was exposed for ornament.

Cup Bolts.—In conveying machinery, screwed bolts with countersunk heads, nicked for a screw driver and having a square neck; they are used to fasten elevator buckets or cups upon the belts of the conveyor.

Cup Center.—In engineering, a device for rapidly finding the centers of round bars. A cup or bell, with a flaring mouth, has a center punch working axially in it; placing the cup squarely over the end of the bar, a blow on the end of the punch marks the center without further trouble.

Cup Chuck.—Also known as *bell chuck*; a lathe chuck, shaped like a cup in which small articles are held for boring or facing, the objects being retained in the cup by set pins protruding through the side.

Cupel.—In metallurgy, a small shallow dish about an inch in diameter, upon which assaying specimens are exposed, within the *muffle*, to the heat of the furnace. The cupel must be porous and very absorbent and is usually made from ashes of the burnt bones of sheep and horses, washed repeatedly, pressed into form by means of a mould and pestle, dried and ignited to expel all moisture.

Cupellation.—A process of assaying precious metals, in which the *button*, formed from the treated metal and lead, is exposed on a *cupel* to a current of air, while undergoing heat in a special type of furnace. The lead is oxidized and absorbed by the cupel, as are various other metals, leaving only gold and silver, to be afterwards separated by acids.

Cup Head Bolt.—In structural work, a bolt having a hemispherical or cup shaped head. It is used chiefly on timber work and is prevented from turning either by a lip underneath the head or a square shouldered shank.

Cup Joint.—In plumbing, a lead joint in which one pipe is tapered to fit into a flared out cup on the other, and the joint soldered.

Cup Leather Press.—In leather works, the mould in which cup and hat leathers are moulded into shape. It consists of two blocks, an upper and a lower, of turned cast iron, the space between the two blocks

corresponding with the intended sectional shape of the leather. The latter is softened in warm water, and squeezed between the two halves of the mould, by means of a central bolt and allowed to harden in place.

Cup Leathers.—1. In engineering, a ring of oil tanned leather forced into a cup shaped outline by a special mould, serving as packing for the plungers of deep well pumps or ordinary bucket lift pumps.

2. In hydraulic engineering, similar leather rings moulded to a cross section resembling the letter U, which are employed as packing for hydraulic plungers, the pressure forcing the leather against the ram or the stuffing box. Also known as *U leathers*.

Cupola.—1. In architecture, a curved or spherical roof, resembling an inverted cup, covering a circular, square or polygonal chamber; a small *dome*.

2. In foundry work, a vertical or shaft furnace, usually of cylindrical section, in which pig iron is remelted for purposes of casting. The lower portion is commonly *boshed* or tapered and the *tuyeres* are disposed about fifteen or eighteen inches above the floor or hearth. Provision is also made for running off the *slag* from the surface of the molten iron.

Cupped.—In machinery, depressed at the center; dished. The depression around the eye of a millstone is called the *bosom*.

Cuprite.—In minerals, the red oxide of copper; red copper; an important ore of copper, occurring massive and in isometric crystals.

Cuprum.—In chemistry, the technical name for *copper*.

Cup Shakes.—In timber, a defect in which one layer or ring of the wood is separated from the rest, supposed to be occasioned by wrenching of the fibers during severe wind storms. This defect is especially noticeable in hemlock.

Cup Valve.—1. In steam engineering, a cup shaped or conical valve which is guided by a stem to and from its flaring seat.

2. A form of balance valve which opens simultaneously on top and sides.

3. A valve formed by an inverted cup over the end of a pipe or opening.

Cur.—An abbreviation for currency; current (the present month).

Curb.—Something which checks, confines, restrains or retains in place; or to apply such a curb; specifically:

1. A row of curbstones bounding a foot walk.
2. A sort of parapet or retaining wall of stones or masonry retaining and reinforcing an earthen slope or embankment. In this and the previous sense, the word is more usually spelt *kerb* by civil engineers and architects.

3. A ledge upon the top of a wall; a ring of masonry or concrete surrounding and supporting the mouth of a well or shaft.

4. A wooden framing, form or centering, employed in building a curb around a well; a framing or reinforcement of timber or iron work used to reinforce it when built.

5. A vessel, especially a soap boiling kettle, having an inwardly curved or bent over edge, to prevent the contents from boiling over.

Curb Plate.—In architecture, the wall-plate of a circular or elliptical dome or roof.

Curb Roof.—In architecture, a roof having a double slope, or composed on each side of two parts which have unequal inclination; a *gambrel roof*.

Curb Stone.—A stone set on edge, in a row with others, to bound or add a finish to the edge of a sidewalk; a stone built into a curb wall; a *kerb stone*.

Curd.—A soft solid formed by the addition of an acid to milk; it consists of *casein* and the fats, while the sugar, salts, etc., are contained in the liquid or *whey*; curds are made into cheese. Any soft solid of similar appearance to the curdled milk is given the same name, as in soap making.

Curd Knife.—In dairy appliances, a frame set with numerous blades, longitudinal, transverse or oblique, used to cut up into small cubes the mass of curd formed after coagulation on the top of a cheese vat.

Cure.—To heal, to restore to health or soundness; to make well; to subdue or remove by medical means; to set free from something injurious or blameworthy. In leather manufacture, a material used in curing the skins of animals or preventing them from decomposition before they arrive at the tannery. Common *cures* are salt, arsenic, solutions of boracic acid, and compounds of carbolic acid.

Curing.—1. In leather manufacture, the treatment of skins with an antiseptic cure after flaying, to preserve them during transportation.

2. In sugar manufacture, cleansing the crystals by washing, draining and drying.

Curling.—The act or state of that which curls; as, the curling of smoke when it rises; also, the act or process of one who *curls* something.

Currency.—The denominations of money which pass or are *current* in a certain region or country; the state or act of circulation among people.

Current.—That which moves in a given direction; a flowing or passing; onward motion; hence, a *stream*, especially of a fluid; as, a *current* of water, of air or of electricity.

Current Mill.—A mill driven by a current wheel, and usually on board a moored vessel, with steam driven paddles.

Current Wheel.—In hydraulics, an undershot wheel or paddle wheel, rotated by the force of a flowing stream, used to supply power.

Currier's Knife.—A broad bladed knife used by curriers in shaving leather. It has two handles, one parallel with the blade and the other at right angles to it, the edge of the blade is turned over by means of steels so that it removes only a slight shaving at each stroke.

Curry Card.—A leather or wooden slip with inserted teeth like those of wood-cards, and used for currying animals.

Currying.—In leather manufacture, an elaborate process of scraping, beating and smoothing, whereby leather is brought to an even surface. It is made uniform in thickness, and, especially, has grease worked into it to render it pliable and waterproof. Harness, boot uppers and belting are always *curried*.

Cursor.—A part of a mathematical instrument which slides on the main portion; as, the movable leg of a beam compass; the slide on a Gunter rule; the beam of the trammel; the hand of a barometer; the adjustable plate of a *vernier*.

Curtate Cycloid.—In physics, a cycloidal curve traced by a point without the circumference of the generating circle. A point on the flange of a locomotive wheel describes a *curtate cycloid*; the path traced by the crank pin of the same wheel is a *prolate cycloid*.

Curvature.—The extent or measure of bending; flexure; departure from a straight line in a curvilinear direction.

Curve.—A continued bending without angles; a line which is not a straight line or composed of straight lines.

Curved Surface.—In geometry, a surface, no part of which is plane; it may curve in every direction as in a sphere or spheroid, or may curve in one direction only, as in a cone or cylinder.

Curve of Expansion.—In engineering, the curve traced by the pencil of an indicator during the expansion of steam or other working fluid, after cut off. It is generally compared with two other curves, *isothermal* and *adiabatic*, for purposes of comparison.

Curve Ranger.—A surveying instrument, specially adapted for *ranging curves*, or marking out on the ground a series of points through which the curve of a desired radius shall pass.

Curvilinear.—In architectural and mechanical drawing, a drafting instrument used in describing irregular curves. The various shapes of its marginal outline enable it to be fitted into position so as to project or transcribe the curve required.

Curvilinear Rivets.—In engineering, those disposed in seams upon a curved surface, especially the girth seams of a boiler shell.

Cushion.—1. A soft pillow or stuffed case to sit or recline upon for ease or comfort; hence, anything approximating in use or appearance to a cushion.

2. In decorating, a square pad upon which gliders cut up gold leaf.

3. In building, a stone placed upon the top of a pier from which an arch is built.

4. In engineering, a body of exhaust steam, imprisoned in an engine cylinder before the advancing piston, which by compression serves to absorb the inertia of the moving parts, preventing shocks and jars.

Cushioned Hammer.—In engineering, a belt driven power hammer, in which the beam or shaft is controlled through the interposition of india-rubber cushions upon its various stops and on that part which actuates it. This cushioning prevents rebound from the anvil after striking the work, and facilitates the giving of quick sharp blows.

Cushioning.—The compression of steam behind the piston of a steam engine, occasioned by closing the exhaust before the completion of the stroke. The cushioning serves to absorb the inertia of the moving parts and brings the piston to rest, preparatory for the next stroke.

Cushion Tire.—In vehicles, cycles, etc., a thick non-inflated rubber tire, stronger and harder than a pneumatic tire, and softer than a solid tire.

Cushion Valves.—In hydraulic engineering, small valves fitted to duplex pumps, opening a connection from the steam to

the exhaust port at either end. They provide a means for releasing excess cushioning after the piston has closed the exhaust port.

Cusp.—1. In geometry, a point in a curve where the course of the latter is abruptly reversed.

2. In architecture, a similar point formed by the meeting of curved lines in ornamentation.

Custody.—A keeping or guarding; care; for keeping; preservation or security.

Custom.—Frequent repetition of the same act; way of acting common to many; ordinary manner; habitual practice; usage; method of doing or living.

Customary.—Agreeing with or established by custom; established by common usage; conventional; habitual.

Customer.—One who regularly or repeatedly makes purchases of a trader; a purchaser; a buyer.

Custom House.—The building where customs and duties are paid, and where vessels are entered and cleared.

Cut.—1. To make incision with a knife or similar instrument; to form grooves, furrows or channels; to remove superfluous material from anything, by means of tools with a paring or furrowing action; to divide into small parts.

2. To shape glass, crystal, diamonds and other precious stones by grinding, abrasion and polishing.

3. In geometry, to intersect, as one line crossing another.

4. In engineering, the depth of material removed at one operation from a surface by a machine tool.

5. In typography, a wood engraving.

6. In refining, laboratory work, etc., any portion of distillate from a liquid, taken between a higher and lower limit of specific gravity or temperature, and separated from the remainder, as illuminating oils are the second or third cuts from petroleum in distillation, being preceded by *benzines* and followed by *solar oils*, *lubricating oils* and *tar*.

7. In sugar making, those portions of *massecuite* removed at intervals from a vacuum pan, in crystallizing sugar, similar to the foregoing.

8. In civil engineering, a canal or ditch; a railway cutting.

Cut and Cover.—In civil engineering, a form of railway construction, generally within city limits, where a kind of tunnel is made by *open cutting* the track to the desired depth, roofing it over, and finally covering it with earth.

Cut Gears.—A term applied to toothed wheels whose cogs have been formed by a machine, as distinguished from those whose teeth have been moulded or cast. The former, being mechanically accurate, require less clearance, and therefore run with less noise.

Cut Glass.—In glass manufacture, a fine crystal of flint glass, made from white siliceous sand, red lead, litharge, potassium carbonate and sometimes sodium nitrate. Articles manufactured from this glass are grooved against rotating iron wheels, the abrading material being sand and water; discs of sandstone and slate are used for polishing and grinding; copper wheels with emery and oil delineate patterns on the surfaces; and grooves previously made are rounded and polished on wheels of cast tin, or of cork supplied with *colcothar* or putty powder.

Cuticle.—1. A thin, transparent, dry membrane, devoid of nerves and vessels, which covers all the surface of the body, except the parts which correspond to the nails; the scarf skin; epidermis.

2. The thin, external covering of the bark of a plant.

Cutler.—A manufacturer of knives and edge tools; an artisan employed in the fabrication of cutting implements; very many separate trades are included in this general term, such as *forgers*, *hardeners*, *grinders*, *handlers*, with minute subdivisions in each business.

Cutlery.—Steel instruments possessing a cutting edge, such as surgical instruments, knives, scissors, swords, etc. Although chisels, etc., are made by cutlers, they are termed *edge tools*, as are axes, while saws are separately classified. Small steel articles, such as calipers, gauges, chains, buckles, etc., are made in the same works as cutlery.

Cut Nails.—Carpenters' nails, cut by machine from a strip of iron instead of being forged separately, or made from *wire*, as wire nails.

Cut Off.—1. In engineering, the point at which the motion of the valves closes the port opening of a cylinder to steam, causing the remainder of the stroke to be effected by the expansive power of the fluid. It is generally expressed as a fraction or percentage of the stroke, but sometimes as so many inches.

2. In milling, a partition in a flour dressing machine separating it into compartments corresponding to the different gauges of mesh in the revolving cylinders, thus effecting separation between coarser and finer products.

Cut Off Valve.—1. In steam engines, a separate slide valve fitted to control the admission of steam, when it is necessary

or desirable to cut off the supply at a period earlier than half stroke. Various forms are in use, the more general consisting of a gridiron valve or else flat plates working on the back of the main slide valve, in which there are formed parts for the admission of steam. The main valve controls the exhaust alone, being set to cut off steam at about $\frac{1}{4}$ stroke. The cut off valve is generally regulable by hand or by the governor.

2. In gas engines, of certain types, a special valve actuated by the governor, which cuts off the supply of mixture before the completion of the charging stroke, thus securing *quantitative governing*, with its advantages of a uniform mixture, and better results than by *throttling*.

Cut Piled Fabric.—In weaving, a material having a nap or pile composed of loops, which are afterwards sheared over the top leaving the threads standing erect, as in *velvet* or Wilton carpets.

Cutter.—1. One who or that which cuts; a revolving disc or fixed point made of high grade steel fixed in a holder, socket or handle for cutting purposes, usually in a machine tool; a knife like blade attached to a tool or machine for purposes of paring, shredding or furrowing.

2. In shipping, a double banked rowing boat used by vessels of war; also a yacht or other similar vessel with one mast rigged with jib, forestay sail, mainsail and topsail, carrying spinnakers and balloon sails for racing. Also known as a *sloop*.

3. In glass manufacture, a workman who cuts or grinds and polishes crystal glass; also a tool used to sever sheet glass.

4. A small light sleigh, with a single seat for one or two persons, usually drawn by one horse.

5. In building, a soft brick, used for gauged work, especially arches; so called from the facility with which it can be cut or rubbed down.

Cutter Bar.—In mechanics, a tool holder of various shapes, used to support a cutting point of fine quality steel, for turning, boring, etc.

Cutter Block.—In machine tools, the revolving block or *hub*, in a wood planing machine, or the like; to which the cutting knives are attached.

Cutting.—1. Separating into parts, or dividing, by means of a sharp instrument. The act of incision.

2. In civil engineering, an open trench or excavation for carrying a railway through a moderate elevation. The cuttings generally are proportioned so as to furnish enough *spoil* to form the embankments or *fills* on either side, thus avoiding transportation of material.

3. In soap making, the separation of soap from the half made article by addition of salt or brine in which the *grain soap* is insoluble.

Cutting Angle of Tools.—The angle between the cutting face of the tool and the work upon which it operates, ranging from 15°, with spoke shaves, to 120° with broaches or cutting drifts. The angles, formed in the

tool itself, by its various faces, are considered as *top rake*, *side rake*, *clearance*, etc. With machine tools, the angles differ for the various metals; cast iron and brass requiring more obtuse angles than wrought iron or mild steel; thus, the angle of the cutting edge on a turning tool for cast iron, would be from 53° to 60° or even blunter, while one of 55° would be more suitable for steel.

Cutting Drift.—In mechanics, a rectangular tool with serrated cutting edges for driving through holes which cannot be dressed by revolving tools. Also termed *broach*.

Cutting Nippers.—A sort of pincers, whose jaws are sharpened for cutting wire, etc. They are different from *pliers*, as they have no roughened jaws or lips for grasping the work, their function being cutting only, either at the side or the front of the jaws.

Cutting Pliers.—Grasping instruments for wire workers' use, having usually a square nose with roughened edges for seizing and twisting wire, with a cutting blade at the root of each jaw between which the wire may be cut.

Cutting Press.—A bookbinder's or printer's press, in which sheets, pamphlets and printed matter generally are trimmed to a uniform size. A favorite machine is known as the *guillotine*, on account of the shape and action of its knife.

Cutting Tool.—A keen edged tool, for machine or hand, used to shape objects by removing superfluous material therefrom. In a specific sense, the name is applied to long slender tools such as are used in a slotting machine where the point extends a long distance from the tool post, necessitating careful selection of the angles to which the edge is ground.

Cutwater.—1. In navigation, the fore part of a ship's prow which cuts the water.
2. A structure attached to the pier of a bridge, with an angle or edge directed *up stream* in order to better resist the action of water, ice, etc.; the sharpened upper end of the pier itself.

Cuvette.—1. In glassmaking, the vessel in which molten plate glass is borne to the table for rolling.

2. In metallurgy, a *parting flask*, or one with a small body and a long slender neck in which metals are dissolved for assaying.

Cwt.—An abbreviation for hundred-weight.

Cyanide.—A salt of hydrocyanic acid, otherwise regarded as a compound of cyanogen with a metallic base; the most important are the cyanides of potassium, silver and mercury. In a crystalline form, cyanide of potassium is known to electroplaters as *cyanide powder*.

Cyanide of Potassium.—A white crystalline solid, highly poisonous and a powerful reducing agent, formed either by strongly heating potassium ferrocyanide or by neutralizing hydrocyanic acid with caustic potash. This cyanide is much used in photography, electroplating and laboratory processes; a weak solution readily dissolves finely divided gold, and is therefore employed to treat slimes and poor ores, especially those which have already been through the amalgamation process. The gold is subsequently precipitated from the solution by zinc, and the resultant cake is refined by cupellation.

Cycle.—1. A series of operations forming a closed circle, a fresh series beginning where another ends; as exemplified in the course of the steam with a marine engine, it being generated in the boilers, passing through pipes to the engines, doing work successively in the various cylinders, by virtue of the elastic force stored in it while being formed; escaping at a low exhaust pressure to the condenser, where it is converted into water, and as such returned to the boiler once more.

2. A circle; a wheel, from the Greek *cyclus*, a circle.

3. The cycle of operations within the cylinders of an internal combustion motor; termed *two cycle* or *four cycle* on account of the number of strokes of the piston required to complete the series in each case.

Cyclic Phase.—In physics, an expression denoting the orderly and cyclic succession of the various motions in a heat engine; as, *pre-admission*, *admission*, *expansion*, *release*, *exhaust*, *compression*, in a steam engine; and *suction*, *compression*, *explosion*, *exhaust*, in an explosion engine.

Cycloid.—In drawing, a curve generated by a point upon the circumference of a circle rolling upon a straight line.

Cyclone.—A violent storm, often of vast extent, characterized by high winds rotating about a calm center of low atmospheric pressure. This center moves onward, often with a velocity of twenty or thirty miles an hour.

Cyclopedias.—The circle or compass of the arts and sciences; circle of human knowledge; hence, a work containing, in alphabetical order, information in all departments of knowledge.

Cylinder.—1. A circular body generated by the rotation of a straight line around an axis and parallel to same; a bored or hollow surface of a cylindrical outline; as, the *bore* of a barrel of a gun.

2. In engineering, the essential part of a reciprocating engine; consisting of a cylindrically bored chamber with sealed ends, in which work is done by a fluid upon a *piston*, in moving it alternately from one end to the other.

3. In printing, a hollow revolving drum forming an important feature of various classes of presses; as, a *cylinder press*.

4. In typewriting machines, a drum or roller, usually covered with vulcanized rubber, which feeds the paper vertically and supports it under the blow of the type bars so that a proper impression is made.

Cylinder Boiler.—A plain cylindrical shell with hemispherical ends, so that little or no staying is required. It is mounted on brickwork and externally fired. The boiler is cheaply constructed and easily cleaned, but the expensive masonry setting counter-balances the cheap boiler. It is a wasteful generator of steam, is liable to corrosion, and consequently to disastrous explosion from its large water contents. Known also as *egg ended boiler*.

Cylinder Bore.—The bore of a cylinder, as of a steam engine.

Cylinder Capacity.—The volume of a cylinder, or the area of the piston multiplied by its stroke, and therefore a direct measure of the power of an engine. With *automobiles* and *motorboats*, classification for contents is based upon the cylinder capacity or *volume swept through by piston*.

Cylinder Cock.—A faucet or rotary valve used to free the steam cylinder of an engine from condensed water, more generally termed *drain cock*.

Cylinder Cock Rigging.—In a locomotive, the arrangement of rods and levers whereby the drain or pet cocks are manipulated from the cab.

Cylinder Cover.—In engineering, a circular disc of cast iron, which may be flat, ribbed or dished, forming the steam tight lid of a cylinder, usually at the end opposite to that through which the piston rod passes. With engines of moderate and large size, the covers are double, with stiffening ribs between the two walls. If single, the space between the ribs is filled with asbestos and cotton wool, and an ornamental cover plate fitted.

Cylinder Head.—In engineering, a term applied to the cylinder covers of a locomotive, or other steam engine.

Cylinder Jacket.—In steam engineering, the covering placed around a steam cylinder to lessen radiation.

Cylinder Lock.—In carpentry, a door-lock, the body of which has a cylindrical form, placed in a bored hole in the wood, thus being easily and neatly fitted.

Cylinder-metal.—Strong or slippery iron used specially for steam cylinders and liners.

Cylinder Oil.—A heavy mineral oil, of considerable viscosity and a very high flash point, used to lubricate the cylinders and valves of a steam engine. On account of the high temperature organic oils may not be used, and a *flash point* of 500° or over is necessary.

Cylinder Paper Machine.—In *paper making*, a simpler type than the Fourdrinier, used for making coarser paper. A large wire cloth cylinder revolves in a trough into which the pulp is fed, the latter adhering to the cloth, the water escaping through the cloth and along the axis. As the cylinder revolves, a *couch roll*, fixed above its highest point, removes the sheet, and it passes through press rolls and driers. This machine having no *shake*, makes thin uneven paper with a lengthwise grain. To remedy these defects, two or more cylinders are combined, and the sheets running on one wet felt, are pressed into one web of the desired thickness.

Cylinder Press.—In typography, a type of printing press in which an impression is taken by means of a revolving cylinder, the form of type being traversed underneath it on a table or carriage, the function of the cylinder being solely to impress the paper upon the type. Those machines in which the type is carried upon the cylinder are known as *rotary* or *web* presses.

Cylinder Ratchet.—In a typewriter, the ratchet whereby the cylinder is partially rotated at the completion of each line, thus feeding the paper and giving a space between the lines.

Cylinder Saddle.—A characteristic feature of locomotives, in which each cylinder, together with its steam and exhaust pipes, etc., forms one half of a structure, which unites the leading end of the frames and affords a concave support for the front end of the boiler.

Cylindrical.—Having the general form of a cylinder.

Cylindrical Flue Boiler.—In engineering, a name applied to a type of boiler consisting of a plain cylindrical shell having a few longitudinal flues. The boiler is suspended over the furnace and the products of combustion return to the front through the flues, and thence to the chimney.

Cylindrical Gauge.—In instruments, a gauge composed of two pieces, a plug gauge or solid cylinder furnished with a handle, and a collar gauge or hollow cylinder into which the plug gauge fits. These gauges are used as templets for boring and turning parts of machines which are required to correspond in dimensions, the plug gauge being inserted into a bored hole and the collar gauge being slid over the spindle or shaft which is required to fit the bored hole. The use of gauges is not subject to the errors incidental to the handling of calipers.

Cylindrical Projection.—In drawing, the projection or throwing forward by progressive determination of points, lines and surfaces of cylindrical bodies.

Cylindrical Ring.—A circular piece of material, like a section of a tube, in which both the interior and exterior are cylindrical surfaces.

Cylindrical Tubular Boiler.—In engineering, a development of the cylindrical flue boiler, in which the products of combustion from the fires beneath the boiler, return to the front through numerous small tubes.

Cypress.—In building, a species of tree growing in many parts of the world, whose wood is soft, light grained, easily worked and of various colors. In the United States, it is used for roof shingles, and fancy trim work in carpentry.

D.—The fourth letter of the English alphabet.

Daimler, Gottlieb.—Born 1834, at Schorndorf in Würtemberg, died 1890. He was the inventor of an oil engine. He went to England, and labored in the works of Sir Joseph Whitworth; next he joined Dr. Otto, near Cologne, and aided him in the production of the Otto gas engine in 1870. He became director of the gas motor factory, but resigned in 1882, to devote himself to the construction of light, high speed gas and oil engines, and later, in 1887, to the invention and development of the motor-propelled carriage which bears his name.

Dalton's Law.—The pressure exerted on the interior walls of a vessel containing a mixture of gases is equal to the sum of the pressures which would be exerted if each of the gases occupied the vessel alone.

Dam.—A bank or mound of earth, or any wall, or a frame of wood, designed to obstruct the flow of water. In mining, an underground wall or barrier constructed of masonry or clay, to keep back water or gas.

Damage.—Any permanent injury or harm to person, property or reputation; an inflicted loss of value; injury; harm.

Damper.—A valve or door regulating the flow of heated gases through a chimney or the entrance of air into the ashpit, thus controlling the rate of combustion.

Damper Regulator.—A device for controlling the rate of combustion in stationary boilers; a piston or weighted lever is connected by suitable mechanism with the dampers in the throat of the chimney, so that the gases may be throttled as steam exceeds or falls short of the required pressure.

Damper Weight.—In steam engineering, a counter-weight attached to the damper of a boiler smoke stack, to aid in the adjustment of the damper.

Damping.—In bleaching, a process whereby a certain amount of moisture is added to a fabric.

Dampness.—Moderate humidity; moisture; fogginess.



Damp Proofing.—A layer of water proof materials, placed in the walls of buildings at a little height above the ground, to prevent the rising of moisture in brickwork due to capillary attraction.

Damp Steam.—In steam engineering, a term used in the same sense as *wet steam*.

Damsel.—The detachable upper portion of a mill stone spindle, furnished with wings or projections to shake the *shoe* or loose lower portion of the hopper which feeds the grain.

Dam Stone.—In metallurgy, a stone occupying one side of the hearth of a blast furnace over which the slag flows, and through which the molten metal is tapped.

Dandy Roll.—In paper making, a cylinder of wire cloth pressing upon the traveling web between the two suction boxes of the machine. Raised wires upon the dandy roll make the web thinner at that point and imprint watermarks and designs upon it. If the wire is fine and without projection the paper is said to be *wove*, if parallel wires are used, it is said to be *laid*.

Darby, Abraham.—Born 1677, died 1717. An English iron manufacturer. He established brass founding works in 1704, but believing that iron might be utilized instead of brass for many common implements, he experimented with iron casting in molds of sand. In 1708, he patented this new method of casting, and thereafter many utensils, hitherto imported into England, were manufactured cheaply to the great relief of the poorer classes. His son, Abraham (1711-1763), carried on his father's business, and achieved distinction by introducing the use of coke in place of charcoal to smelt iron ore, while the third Abraham Darby (1750-1791) added further luster to the name by building the first iron bridge ever erected (1769).

Dart.—A pointed poker, with spearlike shape, used in furnaces to remove clinkers.

Dart Union.—A lip union, in which the surfaces in contact are shaped so as to make a ball and socket joint for each other; very useful in locations where it would be inconvenient or impossible to reach a union of the ordinary type to renew a gasket.

Dash Coil.—A complete induction coil, for jump spark ignition of internal combustion engines, with an element for each cylinder, the whole being enclosed in one case, with dash connections to the commutator upon the engine or cam shaft.

Dash Pot.—A cylinder employed in steam engines which are fitted with trip gears; the dash pot is provided with a coil spring, a piston acted upon by steam, or an airtight piston, behind which is a vacuum; the object in either case being to close the admission valves suddenly, as soon as they are released by the trip.

Dashwheel.—In bleaching, an older type of washing machine, consisting of a drum or wheel, divided into compartments, and revolving in a tank with its lower third submerged.

Data.—Things given; the plural of the Latin *datum*. Particularly:

1. Necessary details relative to a mathematical problem which are given when the problem is set.

2. Information, dimensions and particulars collected either by experience, study or research, respecting technical subjects.

Datum Level.—The base line of a section from which all the heights and depths are measured in the plans of the earth work of a railway.

Datum Line.—In civil engineering, any line from which the surveyor makes his calculations, or from which the dimensions are given.

Daubing.—In founding, the process of repairing the lining of a cupola with fireclay or other refractory material, preparatory to its daily use.

Davits.—Curved or F shaped uprights fitted with tackle to raise, lower or suspend a boat. A davit used for fishing the anchor is called a *fish davit*.

Davy Lamp.—A miner's safety lamp in which the air passages are covered with a cylinder of finely woven copper gauze, to cool the products of combustion to such an extent that surrounding gases will not be ignited by them.

Day Work.—1. Work paid by time instead of by the piece.

2. Work executed on board ship by those who do not keep watch, but are occupied during the hours of day light.

D Bit.—A boring instrument, usually to finish a previously bored hole to a standard size, having a semi circular or D head, the body or stalk being reduced below size for clearance.

Dead Blow.—In blacksmithing, a blow given with a firm grasp on the hammer handle, so as to overcome its elastic character.

Dead Bright.—In machinery, a term applied to the surfaces of machinery which are finished with dead smooth files and oil until all tool marks are erased, the grains closed up and a polished face appears.

Dead Center.—1. The point at which the connecting rod of a steam engine has no power to turn a crank. It occurs when the position of the crank shaft, crank pin and connecting rod are all in a straight line; that is, at each end of a stroke.

2. The dead center of a lathe is the loose head stock, so called to distinguish it from the live center or fast head stock.

Dead End.—Also called *dead head*. The tail stock of a lathe containing the dead spindle and back center; in contradistinction to the live head or head stock at the other end of the shears, which contains the *live spindle*.

Dead End of a Pipe.—The closed end of a pipe or system of pipes.

Deadening.—In building, filling or lining material, used to render walls and floors less pervious to sound.

Dead Eye.—1. In navigation, a block without a sheave, probably so named from a grotesque resemblance to a *dead head* or skull. Also called *ram block*.

2. In machinery, bearings without any line of division, such as exists in a plummer block. It answers the same purpose, but has no adjustment and is used instead of a plummer block in rough work only, or for temporary use.

Dead Gold.—Unburnished gold.

Dead Grate.—Those portions of the grate bar surface, along the fire box sides and ends, without openings for air supply; generally formed as a trough on the edges of which are hooked the other bars, the hollow being filled with fire clay.

Dead Head.—In founding, the metal which fills the ingate of a casting, more especially if the gate is made of large size with the intention of compressing the casting by its weight, or of receiving any slag or impurities which would otherwise spoil the casting.

Dead Hole.—In machinery, a hole bored in metal for a certain distance, but not entirely through.

Dead Knife.—In cutting machines, especially those used on paper, the stationary or fixed blade, against which the moving blade works.

Dead Level.—In construction work, a term used to express that the level is perfect.

Dead Light.—A brass or iron lid fitted to posts or scuttles to close them watertight when necessary.

Dead Load.—One that is put on by imperceptible degrees and that remains steady; such as the weight of a boiler or an engine on its foundation; opposed to live load.

Dead Man.—In rigging, a post put solid in the ground to which to fasten guys; or for furnishing any fastening or anchoring.

Dead Melting.—In a foundry, the practice of allowing the metal to remain in the furnace an extra length of time, in the fluid state, before drawing it off. By so doing, the temperature is increased over that of the ordinary melting point.

Dead Plate.—That part of the bottom of a furnace which consists simply of an iron plate, on which the fuel is first thrown.

Dead Point.—The extremity of stroke of a piston in either direction, when it is unable to exert any rotative effort upon a crank.

Dead Reckoning.—Navigation by chronometer and the log, as in thick weather when observations cannot be taken.

Deads.—Refuse rock thrown out in mining; the gob or goaf of coal mines.

Dead Smooth File.—The finest cut file made. A 12 in. dead smooth file contains about 88 lines of teeth to the linear inch.

Dead Spindle.—The arbor of a machine tool that does not revolve; the spindle of the tail stock.

Dead Water.—In steam engineering, the water which lies below the heating surface in a steam boiler, and where circulation is extremely sluggish.

Dead Weight.—Weight or load directly applied to an object, as in a deadweight safety valve.

Dead Weight Safety Valve.—One in which the weight presses directly on the safety valve spindle without the interposition of levers.

Deadwork.—In mining, that preparatory, such as sinking shafts, erecting buildings, and plant for dealing with the products, which is not in itself remunerative, although necessary.

Deafening.—In architecture, the lining paper used to prevent the passage of sound through floors, partitions, etc.

Deal.—In timber construction, a plank 12 feet long, 11 inches wide and $2\frac{1}{2}$ inches thick. Deals are sawed of other sizes, but are reduced to that cubic dimension in computing them.

Deal Frame.—In saw milling, a *gang saw* for slitting deals or barks of pine timber, by more than one saw. The frame is so constructed that the saws can be set at different spaces to suit the dimensions of the required timber. The saws are of a smaller diameter than the one commonly used for cutting logs.

Decade.—A group or division of ten, especially a period of ten years.

Decagon.—In geometry, a plane figure, having ten sides and ten angles. A regular decagon is one in which all the sides and all the angles are equal.

Decalcomanie.—The art of transferring pictures from specially prepared papers to the surfaces of glass, porcelain, etc.

Decapod Locomotive.—A heavy freight engine having a leading pony truck and ten coupled driving wheels, expressed by the notation 2-10-0.

Decay.—To pass gradually from a sound, prosperous or perfect state, to one of imperfection, weakness or dissolution.

Decennium.—A period of ten years.

Decimal Equivalent.—A fractional or duodecimal measurement expressed as a decimal; as, .0625 is the decimal equivalent of $\frac{1}{16}$.

Decimal Fraction.—One whose denominator is always 10 or 100 or 1000 or some other power, as it is called, of 10,

but its numerator may be any number. For example, $\frac{1}{10}$, $\frac{1}{100}$, $\frac{1}{1000}$ are three decimal fractions, but are usually written without the denominator—thus: .1, .01, .001 the number of ciphers in the denominator being indicated by the number of places in the numerator to the right of a period called the *decimal point*.

Decimal Point.—A dot or mark used in arithmetic to denote the boundary between whole numbers and fractions in decimal notation.

Decimals.—Numbered or proceeding by tens; having a tenfold increase or decrease, each unit being ten times smaller than the unit next smaller, as a decimal coinage.

Decimal System.—A system of weights and measures in which all gradations are expressed as some power of ten, thus facilitating computation. The coinage of the United States is on the decimal system as \$1=10 dimes=100 cents=1000 mills.

Decimeter or Decimetre.—A measure of length in the metric system; one-tenth of a meter, equal to 3.937 inches.

Deck.—In a locomotive, a term applied to the foot plate or floor of the cab. It usually consists of an iron casting which unites the rear end of the frames and provides a connection or drawhead for draw and buffing gear; the flooring of a ship.

Deck Beam.—A part of the framing of a vessel supporting the deck or flooring.

Deck Chisel.—A heavy socket chisel for woodworking. The handle is fitted with a ferrule to prevent splitting.

Deck Crane.—In navigation, a device for hoisting, fastened to a lower deck, and running through the upper deck, over which the crane can be turned to suit the location of articles to be hoisted or lowered.

Deckel.—In paper making by hand, the movable edge or frame around the wire cloth mold on which the pulp is formed.

Deck House.—An erection on a ship's deck.

Deck Scraper.—A scraper with a triangular blade set at right angles to its handle or shaft, much used on shipboard.

Deck Winch.—In ship building, a steam winch bolted to the deck of a ship for hoisting or lowering goods from or into the hold, and generally for doing work whereby manual labor can be avoided.

Declinometer.—An instrument used in meteorology to observe the declination of the magnetised needle, and note its variations; frequently made self registering by periodical photographs. Useful to tell the hourly variations of the magnet and foretell electrical storms.

Decomposition.—The state of being separated; separation into constituent parts; analysis; release from previous combinations; the decay or dissolution consequent on the removal or alteration of some of the ingredients of a compound.

Decoration.—That which adorns or beautifies; something added by way of embellishment.

Decorticator.—A machine for hulling grain or stripping off bark, rind or the outer coat of trees.

Decrease.—To become less; to be diminished gradually in extent, bulk, quantity or amount, or in strength, quality or excellence.

Dedendum.—In toothed wheels, the root of the tooth, or that part within the pitch circle. The dedendum circle is the circle within the pitch circle, to which the bottom of each tooth extends.

Deep.—Extending far below the surface; having a certain depth; the opposite of high.

Deep Sea Lead or Dipsey.—A sounding apparatus used up to 120 fathoms and worked by two men.

Deep Well Pump.—A variety of pump used in non-flowing artesian wells.

Defecate.—To free from dregs or other impurities; to render clear or pure; clarify; refine; as, to *defecate* a liquid.

Defecator.—In sugar making, an apparatus for purifying the raw syrup.

Defect.—A fault or flaw; an imperfection or failing; anything which detracts from the proper operation of an apparatus.

Defer.—To put off; to postpone to a future time, to delay.

Deficit.—A falling short. Deficiency in amount or quality.

Definite.—Having certain limits; as, definite dimensions, a definite measure.

Definition.—A description of a thing by its properties; an explanation of the meaning of a word or term; as, an exact definition.

Deflagration.—A very rapid combustion; a burning up.

Deflection.—1. The alteration in form of any material under stress; deformation caused by the imposition of a load either tensile, compressive, torsional or transverse.

2. The distance or angle by which one line departs from another.

Deflector.—A term of general application for a plate or other suitably shaped fitting employed to turn the course of a stream of liquid or gases into a desired direction; deflectors are commonly fitted to furnaces and fire boxes to direct the course of the hot gases, and to protect the door from the flame.

Deformation.—1. Change of shape; disfigurement.

2. In geometry, change of shape in a body or surface without disturbing the continuity of its parts.

Defray.—To pay or discharge; to provide for; as, a charge, debt or expense.

Degrees.—The circumference of every circle is supposed to be divided into 360 equal parts, called degrees; thus, a degree is $\frac{1}{360}$ of the circumference of any circle. A degree is divided into 60 parts called minutes, expressed by ('), and each minute is divided into 60 seconds, expressed by (") so that the circumference of any circle contains 21,600 minutes or 1,296,000 seconds.

Dehydrator.—In refrigeration, a vessel in which the ammonia gas is passed through trays containing quick lime to remove any final traces of aqueous vapor.

De Laval, Carl Gustaf Patrick.—Born 1845. A Swedish inventor. After a technical university course at Stockholm and several years of study at Upsala, specializing in physics and mathematics, he commenced his career in the service of a mining company, and later became mechanical engineer in the Kloster Iron Works in Germany. There he began producing a series of valuable inventions, the first of which was a strainer for separating air in Bessemer converters, and another a crucible for galvanizing purposes. His experiments on centrifugal

machinery that followed, led to the perfection of his centrifugal cream separator which has proved of immense value to the dairy industry of the world. He also perfected the "lactometer" for determining the percentage of butter-fat in milk. It was his work with the separator that led to his conception of the steam turbine, embodying the principle of the engine devised by Hero 1900 years before. He brought out his inventions in 1882, producing the first practical machine a year later, and in 1888 invented the diverging expansion nozzle, and soon after the flexible shaft, which combined to assure the efficiency of the De Laval steam turbine. He received many high honors at the hands of learned societies and from the Swedish Government.

De Laval Turbine.—A steam turbine acting by impulse or change of velocity, in which the speed of the steam is accepted and the rotation is consequently high.

De la Vergne Machine.—A compression refrigerating machine using ammonia, possessing as a characteristic feature, the injection of a measured quantity of oil into the compressor on the suction stroke, to seal the clearance spaces.

Delivery.—1. The discharge of liquid from a pump, pipe or orifice.

2. The power or product delivered by a machine.

Delta.—1. The fourth letter of the Greek alphabet.

2. An alluvial deposit formed at the mouth of a river.

3. The name adopted for a bronze alloy, containing cast iron.

Delta Metal.—In metallurgy, an alloy of copper and zinc, with a small quantity of iron. It is prepared in various grades, both cast and forged.

Demi Circle.—A surveying instrument for measuring angles, having a semi circular limb furnished with sights, compass, etc.

Demy.—Pertaining to, or made of, the size of paper called *demy*; as, a *demy* book.

Denature.—To add an adulterant to an article so as to render it unfit for its natural use without spoiling it for some subsidiary purpose; as, denatured alcohol.

Denatured Alcohol.—Alcohol which has been rendered unfit for use as a beverage by the addition of wood spirit or kindred substances, without greatly impairing its qualities as a combustible.

Denominate Units.—A unit which specifies the kind of thing measured; as, one day, one month.

Denominator.—In a vulgar fraction, the figure below the line.

Dense.—The state or quality of a substance, whose constituent particles are closely packed together; thick, compact, of close texture or opaque; the opposite of thin or rare.

Dense Air Refrigeration.—Mechanical cooling which is done by an air machine.

Density.—Closeness of parts, compactness. The amount of salt held in suspension in boiler water is spoken of as density.

Dent.—A slight depression, or small notch or hollow made by a blow or pressure; an indentation.

Department.—Sub-division of business or official duty, especially one of the principal divisions of the executive management of a modern machine shop, and the like.

Dephosphorization.—In metallurgy, the removal of phosphorus from combination with iron and steel; as, in a blast furnace.

Depilation.—In leather making, the process of removing the hair from skins or hides; usually accomplished with lime—hence, also known as *liming*.

Deposit.—1. Geologically, any material that has been thrown down from water, or collected by the same agency.

2. In mining, any accumulation of ore, more especially if in beds rather than in veins or lodes.

Deposition.—An action whereby matter in solution is precipitated upon a surface, as the process of electro *deposition*, in which a coating of precious metal is bestowed upon base or inferior material.

Depreciation.—A lowering in value, quality or estimation. In accounting, a percentage of the value of property deducted annually.

Depressed Track.—In railroad engineering, a track which is laid on a lower grade than the tracks running alongside.

Depression.—A cavity or hollow; sinking of a surface.

Dept.—An abbreviation for department.

Depth Gauge.—A machinist's tool for ascertaining the depth of holes, etc., consisting of a flat rule or cylindrical rod working within and at right angles to a crossbar. The amount by which the sliding part protrudes through the crossbar is the depth of the hole.

Derailment.—In railroading, the act of leaving the rails; the accidental throwing of a locomotive or car off the track.

Derangement.—The state of being confused or disarranged; put out of order.

Derrick.—An apparatus of the crane type used to lift heavy weights.

Derrick Brace.—A diagonal member of the framing of a derrick, such as is used in well boring. The horizontal members are known as *girts* or *girths*.

Derrick Pole.—A tripod leg of a portable derrick; as, a *gin pole*.

Derrick Stile.—A leg or corner post of a derrick for well boring.

Describing Circle.—The cylinder or circle containing the pencil for rolling a curve.

Description.—An enumeration of the essential qualities of a thing; a report; a sketch or account of anything.

Desiccation.—The act of drying up; exhausting of moisture; to preserve by drying; as, the drying of wood, meat and vegetables, usually done by a current of hot air.

Design.—The preliminary calculation of dimensions and the drawing from those dimensions of the parts of a machine or structure. Much design is based upon actual physical and mathematical research, and, to be worthy the name, should be based upon a new and original arrangement of mechanical details.

Designate.—To mark out and make known; to indicate; to show; to call by a distinctive title.

Destination.—An especial end or use towards which anything tends; a traveler's objective; the terminal point or goal of a journey.

Destruction.—The act of destruction or demolishing; the ruin occasioned by accident.

Destructive.—Tending or fitted to destroy; ruinous.

Desulphurizing.—The process of extracting sulphur from an ore.

Detach.—To part, separate, disconnect; to separate a part from an aggregation of similar units.

Detachable Tire.—In automobiles, a double tube pneumatic tire which is not cemented to its rim, and may therefore be readily detached.

Detail.—A distinct and separate part; an item; one of several particulars.

Detail Drawings.—These are ordinarily of full size, and often are called *working drawings*, as they give all necessary particulars.

Detent Quadrant.—In steam engineering, a sector notched to hold in place a starting bar or reversing lever.

Deterioration.—The state of growing worse.

Detonator.—An explosive capsule containing fulminate of mercury or similar substance, which by electricity or a fuse is caused to detonate high explosives.

Detour.—A turning; a circuitous route; a deviation from a direct course.

Detritus.—That which is rubbed off; the accumulation of pebbles, gravel, and mud worn from rocks by the action of water; debris; waste from boring or grinding operations.

Detrude.—In mechanics, to drive down or out; to thrust or push down forcibly.

Develop.—1. To bring out, or to cause to come to fruition or maturity.

2. In photography, to produce chemical changes necessary to cause a latent image upon an exposed plate to become visible.

Development.—1. The progress of advancing change by which anything grows towards maturity or perfection.

2. In mathematics, the process by which a mathematical expression is changed into another of equivalent value in an expanded form.

3. In geometry, the unrolling of a cylindrical or conical surface.

Devex.—1. Bending downward; as, a girder overloaded.

2. A downward sloping surface; devexity.

Devexity.—In civil engineering, the characteristic of sloping down, or that which slopes down; as, a railway embankment or one side of a retaining wall.

Deviation.—1. Divergence from a course, or rule.

2. The deflection of the mariner's compass owing to the attraction of the metallic masses of which the ship is composed.

Device.—That which is devised or formed by design; a contrivance; an invention.

Devil or Devil's Claw.—A three-pronged rake used for working certain kinds of coal which contain much ash.

Devil or Twilly Devil.—A machine containing a revolving cylinder armed with spikes or knives, for tearing, cutting, or opening raw materials; as, cotton, wool, rags, etc.

Dew.—Moisture, condensed from the atmosphere and gathered in small drops upon the upper surface of plants and other bodies.

Dew Point.—The temperature at which dew would form or condensation would occur.

Dextrin.—A whitish powder, readily soluble in cold water, forming an adhesive or mucilaginous solution.

Diagonal.—1. Crossing at an angle with one of the sides.

2. A line joining two opposite angles of a quadrilateral figure, and dividing it into two parts.

Diagonal Bond.—A brickwork bonding used on thick walls; it does not show on the face of the wall, but is confined to the filling, which is composed of bricks laid diagonally, the corners being filled with wedges of brick and mortar. It is most used with stretcher bonding—where all the bricks are laid lengthwise, and applied at about every six courses.

Diagonal Engine.—A type of paddle engine, in which the cylinders are placed diagonally to the crank shaft, thus permitting a longer stroke than with oscillating engines, and yet keeping the machinery low down in the vessel.

Diagonal Scale.—A scale which consists of a set of parallel lines with other lines crossing them obliquely, so that their intersections indicate smaller subdivisions of the unit of measurement than could be conveniently marked on a plain scale.

Diagram.—1. A skeleton geometrical drawing, illustrating the principles or application of a mechanism.

2. A figure traced by the pencil of an indicator.

Diagrammatic.—A drawing or illustration resembling a diagram in that it consists of lines and symbols rather than an actual representation of the thing in question.

Dial.—A graduated circular plate upon which anything is indicated by a pointer or needle; as, in a steam gauge or numbered faceplate; a magnetic compass used in underground surveying.

Diameter.—A line drawn transversely through a plane figure or solid, passing through its center; the full width from side to side of a geometrical figure, especially a circle.

Diameter of a Circle.—A line passing through its center and terminating at both ends, in the circumference.

Diametral Pitch.—A modern method of computing the pitch of *machine cut* toothed wheels, in terms of a certain number of teeth per inch of diameter of pitch circle. To proportion the speeds of wheels is only a question of the ratio between the diameters, the pitch depending upon the strength of tooth required.

Diamond.—1. A very hard and brilliant precious stone of pure carbon; most brilliant and valuable of the precious stones, and the hardest substance known. India, Brazil and South Africa are the localities where diamonds are most commonly found.

2. In geometry, a figure bounded by four equal straight lines, forming two acute and two obtuse angles.

Diamond Crossing.—A railway crossing where the lines intersect at such an angle as to make a lozenge shaped figure.

Diamond Drill.—A species of boring machine, in which an annular cutter, faced with black diamonds, is rotated by

tubular steel rods, while the detritus is carried away by a stream of water forced through the apparatus.

Diamond Pencil.—An instrument for cutting, used by glaziers and glass cutters.

Diamond Point.—A name given to a hand or machine tool for metal when the surface of the cutting plane is formed like a lozenge or diamond. Diamond point chisels are much used for grooving or furrowing; lathe and other machine tools with this point are much employed for roughing cuts on wrought iron and mild steel.

Diamond Saw.—One employed in stone cutting, consisting of a steel disc upon the periphery of which are mounted black diamonds. The diamonds are inserted in indentations in the blade, in such a manner as to receive the blow or pressure in one direction only, this precaution being necessary to avoid displacement of the "carbons" from their sockets.

Diaper Work.—A variety of surface ornament, either carved or painted, usually repeated in squares or other geometric forms, and applied to the surface of a wall; so called from its resemblance to diapered linen.

Diaphragm.—1. A thin partition.

2. In locomotive smoke boxes, a plate serving as a deflector for sparks, etc., and guiding the gases through the netting of the spark arrester.

Diaphragm Pump.—One in which a flexible diaphragm takes the place of a piston.

Diaphragm Regulator.—Any device by which pressure on a diaphragm regulates the functions of some part of a mechanism; especially in steam motor cars in which the pressure of steam on a diaphragm actuates a needle valve, thus controlling the flow of fuel to the burners under the boiler.

Diathermal.—Capacity for transmitting radiant heat; freely permeable by radiant or reflected heat.

Dictate.—To point out; to prescribe; to communicate with authority; to deliver to a subordinate; as, a command.

Dictionary.—A book containing the words of a language, arranged alphabetically, with explanations of their meanings; a lexicon; a vocabulary; a word book; hence, a work containing

information in any department of knowledge, arranged alphabetically under different heads.

Die.—1. The piece of metal on which is cut a device to be impressed by stamping; as, on a coin, medal, piece of raised work, etc. A good die is essential to satisfactory work and must be made from high-grade steel. The lettering should be all hand engraved and cut from solid stock.

2. One of two pieces of hardened steel forming together a female screw for cutting the threads of screws.

Die Head.—A chuck, ring or disc in a screwing machine which carries the dies for threading bolts, pipes, etc.

Die Holder.—A device for holding a solid die, in connection with a drilling machine, lathe, etc.

Dies.—A screw cutting die formed in two or more sections, fitting into a die stock, and adjustable.

Diesel, Rudolph.—He was born of German parents, March 18, 1858, in Paris, and studied in the schools there until 1870, when he entered the high school at Augsburg, in Southern Germany. He continued his studies in one of the higher trade schools of that city and graduated in 1879. His great ambition was to invent a prime mover of much higher thermal efficiency than the steam engine, and as a result of his investigations he published in 1893, his "Theory and Construction of a Rational Heat Motor." The extensive discussion created by this pamphlet attracted the attention of Friedrich Krupp, the Steel King, and H. Buz, President of the Augsburg Machine Works, and they placed means at the disposal of Diesel, for a practical development of his engine. Since then thousands of Diesel engines have been built, in powers ranging from 20 H. P. upwards, and these are in successful operation in many parts of the world.

Die Sinker.—An engraver of dies.

Die Sinking.—The art and process of forming dies by pressure and subsequent engraving.

Die Stock.—The frame which encloses the dies used in screw cutting.

Die Temper.—A trade term for tool steel, suitable for employment where the surface alone requires to be hard and the material is desired to withstand great pressure.

Difference.—1. That by which one thing differs from another; that which distinguishes or causes to differ; characteristic quality.

2. The amount by which one quantity differs from another; or the remainder left after subtracting one from the other.

Differential.—Relating to, constituting or marking a difference; having different velocities; as, rolls for breaking wheat.

Differential Block.—A chain tackle to which the principle of the differential windlass is applied. A pulley, furnished with projections to fit the links of a chain, has two different diameters, the smaller of which pays out the chain as the larger winds it in.

Differential Brake.—In steam hoisting engines, a band brake, having both ends of the band pivoted to a rocker, but at different distances from the center of the brake shaft, so that the strain brought by the load held, tends to turn the rocker in the direction to apply the brake.

Differential Calculus.—A method of calculating, invented by Leibnitz in 1697, which consists in the investigation of the infinitesimal changes of quantities when the relations between the quantities are known.

Differential Cam.—An arrangement of cams of different outlines, placed together in the valve gearing of gas engines, etc. These cams are slid backwards or forwards upon a shaft by the governor, coming into contact with the roller in turn and thus varying the admission to suit the load.

Differential Engine.—A type of pumping engine, in which the main valves are controlled by an auxiliary engine, this latter being fitted with a cataract arrangement. This exactly proportions the number of strokes per minute to the quantity of water to be lifted, and also alters the travel of the pistons and plungers to suit the load.

Differential Gearing.—The system of bevel wheels, clutches, etc., which permits one wheel of an automobile to travel independently of the other while going around a curve, so that the outer wheel may accommodate itself to the longer path it has to travel.

Differential Pulley.—An arrangement of the differential windlass, in which the velocity of the rope or chain is very small, as it is wound off the smaller diameter while being wound on the larger.

Differential Pump.—1. A pump having two pistons of different diameters, used as an intensifier or accumulator in hydraulic engineering, etc. The fluid under pressure is in contact with the larger piston and the increment of pressure on the smaller piston is proportional to the ratio between the two areas. This device is employed in refrigerating machinery to maintain an excess pressure of oil in the stuffing boxes of the compressors, the larger piston being exposed to the ammonia or carbon anhydride.

2. Steam pumping engines for mines, so arranged that the travel of the pistons and plungers varies with the quantity of water to be lifted.

Differential Screw.—A device for obtaining great pressure through the prolonged action of a small power. A screwed spindle, working within a nut in a press frame, is threaded internally for the reception of another screw of the same hand, but of slightly finer pitch, this last screw being attached to the die head of the press.

Differential Windlass.—A mechanical power in which the power exerted is due to the difference between the velocity of the rope upon two drums of unequal diameters.

Diffuse.—To spread in all directions; scatter; circulate.

Diffusion.—An instrument for measuring diffusion, scattering or circulation of gases.

Diffusion of Gases.—The diffusion through each other which takes place when two bodies of gas are placed in contact. Even if a porous membrane be placed between them this process is only slightly retarded.

Diffusion Process.—In sugar making, the method employed in extracting sugar from beets, the latter being sliced into cossettes, or patterned discs, and then steeped in water to dissolve the sugar contained in them.

Digester.—A strong cylindrical iron vessel in which water is heated until it becomes steam. As it is not allowed to escape, the vapor pressure becomes strong enough to soften and disintegrate animal fiber, bones, etc., which could not be done by boiling in open vessels. It is used in extracting gelatine, the preparation of food products, bleaching cotton rags in paper making, etc. Usually called Papin's digester, from the name of its inventor.

Digit.—1. A finger's breadth.

2. In arithmetic, one of the nine figures or symbols, 1, 2, 3, 4, 5, 6, 7, 8, 9, by which, with the cipher, 0, all numbers are expressed; any number to ten.

Dike or Dyke.—A ditch or channel for water. In mining, a stony wall separating one part of a lode or vein from another; a geologic "fault," or dislocation of the strata, filled with igneous rock.

Dimensions.—The linear measurements of anything; more especially those measurements which are shown upon working drawings.

Diminish.—To make smaller in any manner; to reduce in bulk or amount; to lessen; to abate.

Dingey.—A ship's smallest boat. A kind of boat used in the East Indies, written also *dinghy*.

Dining Car.—A railway car provided with a kitchen and arrangements for serving meals to passengers.

Diorite or Green Stone.—An eruptive rock of nearly the same structure as granite.

Dip.—To perform the action of plunging some receptacle, as, a dipper, ladle, etc., into liquid or soft substance and removing a part; as, to dip out water. In magnetism, the inclination of the magnetic needle.

Dip Circle.—An instrument similar to the dipping compass.

Dip of a Stratum.—In geology, its greatest angle of inclination to the horizon.

Dipper.—The large scoop or bucket used as an attachment to a steam shovel; as, a $1\frac{1}{2}$ yard *dipper*.

Dipper Handle.—In a power dredge that part of the arm attached to the dipper of the dredge; as, in a drainage ditch dredge of $1\frac{1}{2}$ cubic yards capacity the "dipper handle" would be 40 feet and the "boom" 65 feet.

Dipping.—1. The act of lifting or moving a liquid with a dipper, ladle or the like.

2. In *electroplating*, *lacquering*, etc., the act of immersing the work in some acid or solvent to clean it. A bath in which rough articles are steeped for a considerable time is known as a pickle, while a dip acts on surfaces already smooth.

3. In pottery, the process of coating a body of coarse clay with a finer quality of enamel or glaze; effected by plunging the ware into the coating material while that is in a liquid state.

Dipping Compass.—An instrument, sometimes called an inclinometer, used to measure the angle of dip or inclination of the magnetic needle.

Dipping Needle.—A magnetic needle suspended at its center of gravity, and moving freely in a vertical plane, so as to indicate on a graduated circle the magnetic dip or inclination.

Dip Pipe.—A valve in a gas main, so arranged as to dip into water and tar, and thus form a seal. Called also a seal pipe.

Diggings.—Places where ore is dug; especially, certain localities in California, Australia, and elsewhere, at which gold is obtained.

Direct.—1. Straight; the shortest route or method possible; opposite to circuitous.
2. To superintend; to take charge of operations; to control movements, etc.

Direct Acting Engine.—In steam engineering, an engine in which the action of the piston is transmitted directly to the crank shaft.

Direct Action.—In mechanics, a term applied to an engine in which the piston rod is directly connected with the crank, thereby dispensing with beams, side levers, etc.

Direct Expansion.—A system of refrigeration, in which anhydrous ammonia is allowed to expand in a refrigerating coil in the rooms to be cooled. This term is used in contradistinction to "brine circulating" system, in which brine is first cooled and then forced through piping in the rooms where cooling is desired.

Direction.—1. The act of ordering or ruling.

2. An aiming towards some end; line or point of destination,

3. Direct line or course.

Direction of Flow.—Said of the course of a stream of water.

Direction of Force.—In mechanics, the line along which a force acts, whether it is productive of actual motion or of pressure or tension only.

Director.—1. One who directs or guides.
2. Member of a governing body; as, a director in a bank or manufacturing corporation.

Directory.—A book containing the names, residences and occupations of the inhabitants of any place, or of classes of them; an address book; a body of directors. In marine service, a series of hand books of Sailing Directions issued by the Admiralty, giving information to mariners as to the topography of a region, prevailing winds, weather and magnetic conditions, together with an account of commodities obtainable and facilities for repairs.

Direct Rix.—In mathematics, a fixed line either straight or curved, which is necessary for the delineation of a curve or surface.

Dirt.—Whatever, adhering to anything, renders it unclean.

Disbursements.—1. The act of disbursing or paying out.

2. That which is disbursed or paid out.

Disc or Disk.—A cylinder, whose length is very short in proportion to its diameter; a round plate with a hole in its center; in refrigeration, a thin circular piece of cast iron made in halves, so that they may be secured together on a pipe, in order to increase its radiating service; also called a gill.

Disc Brake.—A type of brake in which the friction shoes bear upon the surface of a disc.

Disc Crank.—In machinery, a crank of circular outline on which the metal is sometimes so disposed that the varying motion of the connecting rod is suitably balanced.

Disc Fan.—An air propeller, shaped somewhat like a ship's screw, and mounted in a cylindrical casing, delivering air parallel to its axis.

Discharge.—To set free, to dismiss. In physics, the rate of a liquid flowing out. In marine service, the valve upon a ship's side through which the deliveries from circulating, bilge or air pump is led overboard.

Discharger.—In dyeing and calico printing, a substance used to remove superfluous color.

Discharge Style.—In calico printing, to make the pattern on the already dyed fabric, by bleaching with a discharge, such as chloride of lime.

Discharge Valve.—1. Any delivery valve, as, from a pump, tank, etc.

2. A self acting valve, placed on a ship's side, permitting the circulating water, bilge water, etc., to be discharged overboard, hence the name, while preventing the ingress of water from the sea. Discharge valves are usually mushroom non-return valves, with a weighted spindle to keep them on the seat, and are not supposed to be capable of screwing down, etc.

Disconnect.—To separate or disjoint parts from one another; to take apart, or to remove a piece from the whole.

Discount.—To make a reduction; something deducted from the face value of a note or bill.

Disengaging Hook.—A safety appliance attached to mine cages, to throw off the rope, should over winding take place, and thus prevent accident.

Dished Wheel.—A wheel made concave or convex, so that the hub is inside or outside as compared with the rim or felloe.

Disinfectant.—An agent employed to destroy the germs of infectious diseases; as, heat, sulphur fumes, chloride of lime, etc., are used as disinfectants.

Disintegration.—The mechanical act of separation into particles, as opposed to the chemical process of decomposition or resolution into elements.

Dislocate.—To displace; to disjoint.

Dismantle.—To unrig; to break down; as, to dismantle a ship.

Displacement.—The weight of water displaced by the flotation of a vessel.

Dissociation.—In chemistry, the breaking up of complex substances into simpler ones; frequently by the action of heat.

Dissolve.—To convert from a solid to a fluid state; as, to dissolve sugar in water, resin in alcohol, or a gas in a liquid.

Distaff.—The staff for holding the bunch of flax, tow, or wool, from which the thread is drawn in spinning by hand.

Distance.—An interval or space between two objects; the length of the shortest line which intervenes between two things that are separate.

Distance Piece.—A thimble or sleeve placed over a bolt or rivet to maintain a set distance between the two thicknesses of material which are united by it.

Distance Rod.—A term occasionally applied to the radius rod of an automobile which maintains an exact distance between those parts to which it is attached.

Distance Signal.—A semaphore placed at such a distance from a block station or signal tower that a train can always be stopped short of the latter point; its legal minimum distance is 500 yards. It is used only as an indicator to inform the engineer as to the state of the home signal, and is made with a swallow tail or notch in the blade.

Distillate.—Any liquid that is a product of distillation. The lighter hydrocarbons obtained from the first distillation of petroleum, which have to be redistilled to prepare them for the market; or any similar product of initial distillation which has to undergo further treatment.

Distillation.—An operation by which two or more liquids having different boiling points may be separated. It consists of a still in which the mixed liquids are boiled, and a worm coil in which the resulting vapors are cooled and allowed to run into different receptacles.

Distilled Water.—Water which has been boiled, converted into steam, and condensed again. This process kills any bacteria which may be present and to a considerable extent frees it from impurities which may be held in solution. Can ice is usually made from distilled water.

Distiller.—An apparatus to distill fresh drinking water from salt or impure water.

Distress.—In mechanics, a beam or structure is in distress when it is subjected to undue or excessive stress, or to an amount exceeding the *working stress*.

Distributed Load.—In mechanics, when a load is spread over the surface or area of a beam, girder or floor, so as to weigh it down equally.

Distributing Reservoir.—In water-works, a reservoir which supplies the mains, etc., receiving its own supply through the receiving reservoir from the aqueduct or rising main.

Distributing Valve.—A combination of triple valve, checks and high speed reducing valve, designed especially for use on locomotives with certain applications of the Westinghouse air brake.

Distribution.—In engineering, the operation by which steam is admitted into and taken out of a cylinder at each stroke of the piston.

Distribution Box.—An arrangement of multiple valves in one common chest whereby many pipes are controlled from a convenient central point.

Distribution of Steam.—The control of the steam by the valves of an engine, so that it is admitted to the cylinder, cut off, expanded and released to exhaust in proper sequence.

Distributor.—A spout attachment to the head of a grain elevator, whereby the material, such as wheat, when lifted, is discharged into a desired bin.

Ditcher.—A machine used in excavating trenches, ditches, etc., and depositing the excavated earth on either side. Called also a ditching machine; a combination cultivator.

Ditty Box.—A small box used by sailors in which to stow away small odds and ends of personal property; hence any receptacle for a miscellaneous assortment of small articles.

Diver.—One who dives under water —especially one who makes a business of diving.

Divide.—To separate; distribute; as, to divide a sum of money. In hydraulics, a water shed, the height of land which separates one drainage basin from another; often, a ridge or conspicuous elevation.

Dividend.—The number or quantity divided, or given to be divided, into equal parts.

Dividers.—An instrument, usually with two legs, opening by a joint, for dividing lines, describing circles, etc.; compasses. The term dividers is usually applied to the instrument as made for the use of draughtsmen; compasses, to the coarser instrument used by carpenters.

Dividing Engine.—A machine, built in various forms, for the exact marking off of divisions, graduations, etc., as, in the manufacture of rules, scales, protractors, verniers, etc., or in setting out wheel teeth.

Dividing Head.—On a milling machine, a head provided with an *index plate* for work requiring definite circular divisions, as, in gear milling.

Diving Bell.—A hollow air tight bell or cylinder, open below, and furnished with a contrivance for supplying it with air, in which persons may be lowered into and work in deep water.

Diving Dress.—An elaborate water tight suit, worn by divers when under water in a diving bell. The helmet is of metal, the rest of India rubber. weights are attached to the waist, and the shoes have leaden soles.

Division.—The operation of finding the value of one of a given number of equal parts into which a quantity is to be divided. When one number has to be divided by another number, the first one is called the dividend, and the second one the divisor, and the result or answer the quotient.

Divisor.—That by which a number or quantity is divided.

Do.—To perform; as, an action; to execute; to transact; to make.

Dock.—1. An artificial enclosure in connection with a harbor or river, used for the reception of vessels, open to the waterway or provided with gates for keeping in or shutting out the tide.

2. The slip or space between two piers for the reception of ships; sometimes including the piers themselves; as, to be down on the dock.

Dockage.—A charge for the use of a dock.

Dock Spout.—A spout of telescopic form, constructed of sheet steel, attached to a cast iron turnhead. It is used on waterside elevators to load vessels or barges with grain cargoes.

Dock Yard.—A yard or magazine near a harbor, for containing all kinds of naval stores and timber.

Doctor.—In western river steamboats, a vertical beam engine with crank and flywheel operating four pumps, and

having feed water heaters supported by the frame. Two simple lift pumps draw water from the river and deliver it to the heaters, while the other two or feed pumps, proper, pump from the heaters into the boilers. Each pump has sufficient capacity to supply all the boilers so that one of either kind may be disconnected for inspection or repair.

Dodecagon.—1. In geometry, a polygon figure with twelve sides and twelve angles.

2. A regular dodecagon is one in which the sides and angles are all equal.

Dodecastyle.—A building having twelve columns in front.

Doffer.—In carding, the cylinder which strips off or doffs the fiber from the cards and delivers it as fleece.

Dog.—1. A sort of iron hook or bar, with one or more sharp fangs which may be fastened into a piece of wood or other heavy article for the purpose of moving it.

2. Any part of a machine acting as a claw or clutch; as, an adjustable stop to change the motion of a machine tool.

3. A grappling iron which lifts the monkey or hammer of a pile driver.

4. A click or pallet to restrain the back action of a ratchet wheel by engaging the teeth; a pawl.

Dog Chuck.—A lathe chuck, usually with four independent jaws or dogs; also termed *jaw chuck*.

Dog Head Hammer.—A hammer used by saw setters or plate straighteners, which has a head shaped like a frustrum of an octagonal pyramid, with a hemispherical face. This is used instead of the cross pene or twist hammers as the latter tend to give an oval blow, where a circular one is desired.

Dog Iron.—In construction, an iron strap which has its ends bent in a right angle and provided with sharp points. It is used to connect timber in rafting or in foundation work.

Dog Link.—A contrivance to eliminate the connecting rod, in which a transverse opening or link is formed in the reciprocating rod to give lateral play to the wristpin of the crank; used in donkey pumps and with various forms of valve gearing. Also called *Scotch yoke*.

Dog Power.—A machine operated by the weight of a dog traveling in a drum, or on an endless track.

Dog Tail.—A moulder's sleeking tool, having an oval blade and a curly stem from which it derives its name.

Dolly.—1. In mining, a wooden disk for stirring the ore in a dolly tub, in ore concentration.

2. A block put on the upper end of a pile which the ram or hammer could not otherwise reach.

3. A former for shaping a rivet head; a snap head.

Dolomite.—A mineral consisting of carbonate of lime and magnesia in varying proportions. It occurs in extensive beds as a compact lime stone and common white marble. It is also called bitter spar.

Dolphin.—A cluster of piles driven closely together in the water and united together by braces and stagings, to serve as moorings for vessels.

Dome.—In a steam boiler, a reservoir of a shape approximating to a hemisphere mounted on the upper surface of the boiler to increase the steam room; steam dome.

Dome Cap.—A cover or door for the top of the steam dome.

Donkey Boiler.—The auxiliary boiler carried aboard ship for use in port.

Donkey Engine.—An auxiliary steam engine aboard ship, so called because the early ones were rated at less than one horse power.

Donkey Pump.—A small steam pump used to supply a *donkey boiler* with feed water. Generally, a crank and flywheel piston pump as used for auxiliary purposes on ship board, such as for washing decks and feeding boilers in port; for pumping bilges and ballast tanks, etc.

Door.—1. A doorway; any means of exit or entrance; passageway.

2. An opening in a wall to permit entrance into or exit from a room, building or other enclosure.

Door Knob.—A handle to a door.

Dory.—A small flat bottomed rowing boat for one or two men, used for fishing from larger craft at sea. The larger sizes modified in form, are sometimes propelled by a motor, and used as *launches*.

Dotted Line.—A broken or interrupted line, used in drawings or plans to represent the concealed parts of machinery, or to denote boundary lines. Also employed sometimes in black and white reproductions of working drawings, to represent center and dimension lines. There are many patterns of dot and dash lines.

Double.—Twice as large; composed of two; being in pairs.

Double Acting Pump.—A pump in which the piston forces the water on one side, while drawing it into its cylinder on the other side.

Double Action.—In mechanics, action or power applied in two directions; as, in a cylinder, steam acting on each piston face alternately.

Double Bar Link.—A mode of forming the links of the Stephenson or other valve motion, with two equal and parallel bars instead of a single slotted link.

Double Beat Valve.—A balanced valve, usually consisting of a movable, open ended shell, provided with two faces of nearly equal diameter, one above the other, which rest upon two corresponding seats when the valve is closed.

Double Bend.—A pipe fitting, shaped like the letter S in outline.

Double Chain Drive.—A method of driving employed in motor cars, where the power is transmitted from either end of the transverse countershaft to each driving wheel by a separate chain. Also known as Continental drive.

Double Column Drill.—A machine resembling the boring mill, save that the tool revolves while the work remains stationary, which is the reverse operation to that of the latter machine.

Double Coned.—A class of bearing in which the journal is tapered both ways from the middle towards each side.

Double Crank.—A center crank; one which is designed to connect to either side, as in a marine engine.

Double Cutting off Machine.—1. A pair of circular saws at adjustable

distances from each other, used by box-makers, etc., to trim off materials to dimensions at either end.

2. An axle lathe, whereby the two ends of the axle or shaft are faced or turned, simultaneously.

Double Drill.—One with two cutting portions; as, that which, at the same time, drills a hole and countersinks it.

Double Effect.—A distilling apparatus consisting of two chambers worked in series, under a vacuum, in such a manner that the vapor from the first vessel is the heating agent that vaporizes the contents of the second, thus ensuring great economy. This principle if further extended to three stages forms the well known triple effect, or even to a sixfold distillation, the sextuple effect.

Double End Locomotive.—A type having radial wheels or trucks at each end; usually tank engines for suburban and shuttle passenger traffic where the engine cannot be turned between trips.

Double Expansion.—The same as *compound*; a type of engine in which the steam or other working fluid is expanded in two successive cylinders, doing work on the piston of each, thus dividing the *temperature range* into two stages and thereby reducing the amount of condensation that would occur if the entire expansion took place in one cylinder.

Double Eye or Knuckle Joint.—A joint formed of two forks or jaws, with a cube of iron between them, with a bolt or pin through each jaw and the cube at right angles. Will work freely in all positions from a straight line up to 45°.

Double Geared Lathe.—One furnished with the customary back gearing on the fast or live head stock.

Double Gearing.—A train of toothed wheels, containing two spur wheels and two pinions; as, in the back gearing of a lathe.

Double Header.—A term employed when two engines pull one train.

Double Lift.—A gas holder, consisting of two telescopic rings, which slide within each other or draw out, thus accommodating its capacity to the quantity of gas.

Double Plate Wheel.—A cast iron wheel, in which two plates connect the rim and hub, instead of spokes.

Double Ported Valve.—A type of slide valve in which steam is admitted through two steam ports at each end of the cylinder face, thus reducing the travel of the valve.

Double Riveted.—A riveted seam in boiler making, etc., where the rivets are arranged in two parallel rows.

Double Seated Poppet Valve.—A poppet valve having two valves on one stem, with two seats in the same shell.

Double Seat Valve.—One employed to control alternate passage ways in a pipe, having a seat upon either opening. A well known instance is the valve employed in many small steamers, so that the steam from auxiliary engines may be directed either to the atmosphere or to the condenser, the controlling valve being provided with a seat on each passage, so that either may be closed at will.

Double Shear.—A rivet or bolt is said to be in double shear when it passes through three thicknesses of material, thus exposing its cross section to shearing action in two places, giving each unit double the resisting power it possesses when in single shear or uniting two thicknesses. The accepted standard of boiler riveting is to account a rivet in double shear to possess 1.75 the strength of single shear.

Double Shut Off.—A twofold action for preventing the passage of steam through a pipe, or water through a flume, by closing a cock, valve, or gate. In a steam engine it generally works automatically.

Double Tandem.—A type of engine, employed more especially in textile factories, where a uniform turning effort is important. The engine is arranged as a cross compound, but a tandem pair of high and low pressure cylinders drive each crank.

Double Tube Tire.—In automobiles, a pneumatic tire composed of two concentric tubes, the outer being of stout fabric to resist wear, and the inner constructed of an elastic material impervious to the compressed air which it contains.

Doubling.—1. The act of one that doubles; a making double; also, that which is doubled, a turning and winding.

2. The process of re-distilling, to improve the strength and flavor.

Doubling Plate.—A compensating ring or plate to reinforce an opening in another plate.

Doubling Spindle.—In cotton manufacture, a spindle in a speeder, stretcher or bobbin and fly frame, which doubles and draws the roving in preparing it for the final spinning.

Dough Mixer.—A kneading and incorporating machine in which the previously blended flour, received from an overhead hopper, is worked up into dough for the making of bread and biscuits; the contents when thoroughly mixed being taken on a traveler or conveyor to dividing and moulding machines, for forming into loaves and cakes.

Doup.—In weaving, (1) a loop through which several warp threads may pass; (2) a half heddle provided with loops or mails and placed in front of the ordinary heddles with the object of mutually entwining various warp threads; as, in weaving gauze.

Dovetail.—A manner of fastening boards, timbers, etc., together, by letting tenons cut on one into corresponding mortises in another.

Dovetail Brick.—A brick whose one end is formed like a wedge, and the other end has a recess to receive the wedge like end of the other brick.

Dovetail Cramps.—Slate cramps shaped as a double dovetail, let in between two building stones to fasten them together.

Dovetail Joint.—The junction of two pieces by means of splayed tenons and corresponding mortises of the respective parts.

Dovetail Saw.—A light tenon saw, used for cutting dovetails, and for small work generally.

Dowel.—A pin of wood or metal inserted in the edge or face of two boards or pieces, so as to secure them together. A small peg or pin to attach planks edgewise, as in a cask head; a wooden plug put in a deck to cover up a bolt head.

Dowel Pin.—In founding, a pin or projection, preferably of iron or brass, fitting into a socket of the same material, used to maintain the proper relations of the portions of a pattern which has to be separated in the operation of moulding.

Downcast.—A mining term applied to a shaft or working through which fresh air enters the mine.

Downcomer.—In smelting and refining, the pipe or conduit leading the gases from the top of a blast furnace to the stoves, etc.

Downcomers.—In steam engineering, pipes fitted in water tube boilers to provide downward circulation, generally to mud drums. Also called *down flow pipes*.

Down Take.—A main pipe or conduit, in which the circulating fluid travels downward.

Drachm.—A term of measurement equaling 45 drops of water, or a common teaspoonful. In avoirdupois = $\frac{1}{8}$ oz. or 27.34375 grains.

Draft or Draught.—To make a sketch of, an outline sketch drawn to a scale; in pattern making, a slight taper given to the pattern so that it will draw readily from the mould; see draw taper; in weaving, to pass the warp threads through the mails of the heddles.

Draft Gear.—The means provided for transmitting the pull of the locomotive to the train, or from one vehicle to another.

Drafting Water.—A term signifying raising water by suction.

Draftsman.—A designer; a true engineer who possesses an intimate knowledge of the various processes of manufacture, is versed in the theory of his profession, and possesses mathematical attainments. Upon him devolves the duty of designing machinery, and of making both general and detail drawings.

Draft Spring.—A draw spring to give elasticity to a drawbar.

Draft Timbers.—A pair of longitudinal timbers at each end of a car frame, which carry the draft gear, and in passenger cars are the principal support of the platform.

Draft Tube.—An air tight suction tube fitted to reaction turbines. Several types of these latter may be placed as much as 30 feet above the tail water, if this pipe be fitted, as the weight of the column of water within it balances part of the atmospheric pressure, and the difference of pressure during the flow through the turbine is the same as if the turbine were placed at the bottom of the fall.

Drag.—To pull along by main force; a grapple; a dredge; a brake. In mining—an iron blast hole cleaner. In founding, the nowel or lower casting box; a steel instrument used in completing the dressing of stone.

Drag Anchor.—An anchor which drags in the water; thrown overboard to diminish the leeway of the vessel when drifting.

Drag Link.—A term for the suspension rods or links of a valve gear.

Drag Saw.—A cross cut sawing machine, usually operated by horse power, in which the effective stroke is on the pull motion, instead of on the thrust; the log is clamped by levers, and the saw held aloft by a kind of stirrup.

Drain.—A conduit for the flow of surface water; to exhaust of liquid contents by drawing them off; to make gradually dry or empty; to deprive of moisture. In founding, a trench along which molten metal flows from the furnace to the moulds.

Drainage.—That which is drained off the gradual flowing away of a liquid; the sewage from towns, railroads, mines, etc.

Drain Cock.—A small valve placed on engine cylinders at their lowest points or wherever pockets are liable to occur in the passages, so that accumulated water from condensation or other sources may be blown off; a similar cock fitted for kindred purposes on anything containing or passing liquids.

Drainers.—In paper making, stone vats into which the half-stuff is run from the beating engine or washer.

Drain Pipe.—A small pipe fitted to the drain or drip cocks of a steam engine, etc., to carry away the water.

Drain Valve.—A valve fitted to cylinders and pipes to drain off water of condensation, etc.

Draught or Draft.—1. A current of air; as the *draught* of a chimney.

2. To select for a particular service; as, to *draft* men for war.

3. A nautical term, meaning the depth of water to which a vessel is submerged, especially when loaded.

Draughtsman or Draftsman.—1. One skilled in the art of mechanical drawing.

2. One who prepares and draws up deeds, etc.

Draw.—To pull or haul, opposed to push; to make a picture or diagram; as, to draw a line.

Drawback.—In iron founding, a loose piece in the mould; the same as false core.

Draw Bar.—A bar or heavy beam under the body of a railway car and projecting at the end for coupling cars. The fastening by which a locomotive is attached to its tender; a device by which the pull of a coupling is transmitted to its vehicle.

Draw Bolt.—A device for coupling railway cars, consisting of a short bar of iron inserted through a draw bar head and passing through a coupling link.

Draw Bridge.—A bridge spanning navigable waters, and having one length or span working on a turntable, so that it can be revolved to permit the passage of craft.

Draw Cut.—In shearing and cutting machinery, the gradual severance obtained by inclining the knives or blades to each other.

Draw Eye.—In lime and cement manufacture, an opening at the base of a "bottle" kiln for removal of the calcined material after burning.

Draw Filing.—The polishing of a metallic surface, by drawing a smooth file along it.

Draw Head.—A socket formed in the footplate of a locomotive or secured to the buffer beams, forming a receptacle for the end of the drawbar which is fastened into it by means of a pin.

Draw Horse.—A trestle-like stool with a frame on it to clamp or otherwise hold the work on which a draw knife is used; as, by a cooper in making barrels.

Drawing.—A sketch, or representation with pen, pencil or the like. In spinning, the process of lengthening and attenuating the fibers of cotton, wool, etc., by passing them through series of rollers, each revolving at a higher speed than the preceding; these rollers are arranged in pairs, the upper being covered with leather, and the lower fluted. In spun silk manufacture, the operation

of laying parallel the fibers of silk waste or floss silk, so that after being cut to length, they may be spun as cotton.

Drawing Board.—A board upon which paper is stretched during drawing. The requisites are an even surface and the edges straight and at right angles with each other. Good boards are partially cut through longitudinally, and reinforced by battens on the back.

Drawing Iron.—In foundry work, the same as lifting screw.

Drawing Knife.—A cutting instrument, consisting of a blade with two handles at right angles to it; employed for trimming wood, etc., by drawing towards the user.

Drawing Paper.—Stout paper, made specially for the execution of drawings, plans, etc. The better and more frequently used qualities are still made by hand, but for large drawings it is necessary to use the greater sizes made by the machine. The size and sometimes make of each paper has a distinct name. Those papers most used by draughtsmen and architects are Antiquarian 53"x31", Double Elephant 40"x27", and Imperial 30"x22"; smaller drawings are made on half or quarter sheets.

Drawing Pen.—A pen in which the ink is retained between two flat blades of steel, bent towards each other at the point. The distance between the points is regulated by a screw.

Drawing Pin.—A tack or pin with a large thin flat head used to secure paper temporarily on a drawing board, as in making a sketch or tracing.

Drawing Press.—A machine used in forming deep vessels from sheet metal blanks by the action of dies, employing gradual pressure steadily applied.

Drawing Retorts.—In gas making, the process of pulling the residual coke from the retorts after the volatile constituents of the coal have been distilled therefrom.

Drawing Room Car.—A car for day travel generally run by independent companies on railroads, and fitted luxuriously.

Drawing Scales.—Scale rules used in measuring and making drawings. They are usually constructed of ivory or box wood; also made of stout paper or thin card. A mechanical engineer uses scales of so many inches or such a fraction to the foot; the civil engineer uses, also scales of so many chains or yards to the inch.

Draw Lid.—A sliding lid.

Draw Line.—In well boring, a rope used with pole or rotary drills to lift the tools from the hole.

Drawn Down.—The decrease in cross section dimensions of a piece of metal after swaging or forging.

Drawn Out.—The increase in length of a piece of metal after swaging or forging.

Draw Plate.—A plate of hardened steel, furnished with a series of tapered holes of gradually diminishing diameters, through which metals are drawn out into wire.

Draw Share.—A knife having a handle at each end of the blade and used for cutting with a drawing motion. Also called *drawing knife*.

Draw Span.—The lifting span of a draw-bridge.

Draw Taper.—In moulding, the amount of the taper, greater in a deep casting than in a shallow, which is given to the pattern, so that it can be drawn from the completed mould, without disarranging the sand.

Dredge.—In lead mining, the mixture of grains of lead and ore stone on a dressing table or concentrator.

Dredge Bucket.—A scoop or shovel of rectangular form as used in ladder dredges; it is furnished with a steel or chilled iron lip to cut through the material dredged, and is sometimes fitted with an automatic emptying bottom, through which its contents are discharged.

Dredger.—A vessel fitted with appliances for deepening river channels, harbors, etc., by taking up and removing gravel or mud from their bottoms. For working in hard materials, the dredge consists of an endless chain of buckets working on a ladder.

Dredging Machinery.—Apparatus for enlarging the depth or width of waterways by subaqueous excavation of their bottom or sides. Sandy materials are removed by *suction dredges*, in which a crown or spider, set around the extremity of a curved tube, assisted by jets of water, loosens the sand which is sucked up through the tube by centrifugal pumps.

Dress.—To prepare for service; as, a tool, by means of forging, hardening, tempering and grinding. To trim stones, bricks, etc., to a desired form by removing excess material with suitable tools.

Dresser.—A mallet or beater made of boxwood and used for working sheet lead or pipe.

Dressing.—In textile manufactures, starch, glaze, or stiffening applied to fabrics in the finishing process.

Dressing Floor.—The space or building devoted to the process of ore dressing.

Dressing Stone.—The act or process of cutting and shaping stone to its desired form.

Drier.—1. An apparatus for freeing a substance from moisture, as a steam lumber drier.

2. A substance added to a paint, varnish, or printing ink to make it dry more quickly; a drying oil. Also spelled *dryer*.

Drier Rolls.—In paper making, hollow cylinders of copper, brass, or cast iron, heated internally by steam passing through their trunnions, which dry the web of paper after it leaves the press rolls.

Drift.—1. A round taper tool.

2. That which is driven, forced, or urged along; a mass of any thing carried onward together; as, matter which has been driven or forced onward into its present position; as, a drift of sand.

3. A nearly horizontal gallery in a mine.

Drifting Pick.—Also known as *quartz pick*, a stouter and shorter form than the common surface or excavating pick.

Drift Pin.—A round steel pin designed to smooth and enlarge; as, a rivet hole in an iron plate.

Drift Test.—An examination, whereby iron plates, etc., are tested for tenacity by driving conical pins into small holes to see if the metal cracks or breaks.

Drill.—A pointed cutting tool, usually round, for boring in metal or other hard substance and driven by a machine or brace.

Drill Bit.—A tool for boring a hole in metal, distinguished from the drill by its application to lathe work; as, *cylinder lathe bit*, *rose bit* and *flat bit* for the lathe.

Drill Bow.—The bow used to rotate a riddle drill.

Drill Chuck.—A self centering chuck which holds small twist or wire sized drills in a drilling machine, spindle or lathe headstock.

Drilling.—The customary term for well boring.

Drilling Machine.—One for boring or drilling. It may be, (1) *multiple*, in which case there are several drilling tools which may be operated together; (2) *pillar*, in which an upright post bears a table with adjustable tables; (3) *radial*, in which the tools on a horizontal swinging arm and may thus cover any point within a circle.

Drilling Scow.—A scow fitted with apparatus for boring or excavating rocks under water.

Drill Pole.—In well boring, a rigid connecting length between the drilling tools and the machine that operates them.

Drill Press.—A machine tool for drilling holes, consisting of a table for the reception of the work and an iron frame in which are mounted a vertical revolving spindle to carry the drill or cutter, and mechanism to drive the same at varying rates of speed and power.

Drill Socket.—A tapered sleeve or socket, bored out to standard sizes, to receive twist or common drills.

Drill Spindle.—The vertical revolving shaft of a drilling machine, which rotates the drill. It is composed of two parts, the spindle proper which revolves, and the upper part which is provided with a thread or rack through which the drill is fed into the work.

Drill Stock.—A device for rotating a drill by hand.

Drill Test.—A test for wastage of boiler and other plates by means of drilling small holes, to caliper the thickness.

Drip.—1. To shed in drops.

2. A dripping; as, of water from a roof, or the falling of liquid during distillation.

3. A drain cock upon an engine or steam pipe.

4. An architectural term applied to the overhanging part of a cornice.

5. A dripstone for filtering.

Drip Pan.—In machinery, a pan of sheet iron placed underneath a machine to receive and save the superfluous lubricating oil.

Drip Pipe.—A device used to draw off the water of condensation from systems of piping, steam cylinders, heaters, etc. Drain cocks are used for similar purposes.

Drip Valve.—In railway work, a small valve attached to the brake drain pipe, to clear it of accumulated water. Also termed bleeder.

Drive.—To push or propel with force. In mining, to excavate a passage or working nearly horizontally.

Drive Bolt.—A tool for driving bolts home, called also a drift bolt; one used to drive out another bolt.

Drive Chain.—A chain for power transmission, composed of uniform links of malleable iron, working over suitable sprocket wheels. Also known as link belting.

Driven Pulleys.—When two pulleys are working together, connected by a belt, the one which receives the motion is called the driven pulley.

Driven Well.—A tube well; a small bore well made in soft strata by driving a tube into the ground to tap the water-bearing stratum. The tube is shod with a sharp point, perforated to admit the water.

Drive Pipe.—Heavy casing with substantial sockets, which is driven or forced into a bore hole, to shut off water courses, or prevent caving.

Driver.—That which communicates motion to something else, especially a wheel that transmits power to another wheel, and the part of a lathe that gives motion to the carrier; the driving wheel of a locomotive. In founding, a curved iron bar for use in tamping; a tool for driving hoops on a cask.

Driver Coupling.—A flange coupling connection, in which the bolts are headless and parallel, being fixed in one flange and more or less free in the other.

Driver's Valve.—The valve in the cab for controlling the Westinghouse brake, called also engineer's valve.

Driving Axle.—That axle of a self propelled vehicle, etc., through which the power is transmitted to the wheels.

Driving Chisel.—A chisel beveled on both edges.

Driving Fit.—A term applied to such a relation in point of size between a spindle and the hole which receives it, that the former has to be forced into place by blows from a hammer or mallet.

Driving Gear.—A general term, signifying the gearing belts, pulleys, clutches, shafting, etc., whereby motion is transmitted to a machine.

Driving Home.—In machinery, a shop term used to signify that the object is driven to its permanent position.

Driving Pulley.—That pulley upon a live shaft which imparts motion to the countershaft of a machine or a second line of shafting.

Driving Rod.—In railway engineering, the rod connected to the piston rod and driving the main wheel of a locomotive. Also called *connecting rod*.

Driving Rope.—Endless rope for transmitting power by friction from a driving to a driven wheel, sheave or drum.

Driving Shaft.—A shaft communicating motion from the motor to the machinery.

Driving Side.—In millwrighting, that side of a belt which drives the pulley.

Driving Spring.—In a locomotive, the spring fitted to the driving axle box by means of which the due proportion of weight is transmitted from the engine to the wheels, absorbing shocks, etc., by its elasticity.

Driving Wheel.—A wheel communicating motion to one or more wheels or impelling a machine, specifically, a wheel on a locomotive receiving the force of a piston rod through a connecting rod.

Drizzle.—A light rain falling in fine drops.

Drop.—1. The quantity of fluid which falls in one small spherical mass; a liquid globule; hence, also, the smallest easily measured portion of a fluid; as, a drop of water.

2. A machine for lowering heavy weights; as packages, coal wagons, etc., to a ship's deck.

3. The distance of a shaft below the base of a hanger.

Drop Box.—In figure weaving, a receptacle containing numerous shuttles with different colored threads, so arranged that each can be brought into action at the proper time as required by the pattern. See shuttle box, and picker chain.

Drop Elbow.—A gas fitting, consisting of an elbow, or 90° bend, fitted with two lugs for holding screws or bolts.

Drop Forging.—A small article of iron or steel, such as parts of sewing machines, firearms, etc., made by properly shaped dies under a drop hammer. The metal is heated and placed in the lower die, the force of the blow forcing the material into all the recesses of the mould, the exact shape of which is reproduced.

Drop Grate.—A panel or portion of a fire grate fitted on a hinge, so that it may be dropped to clear it of ash or clinker.

Drop Hammer.—A forging machine consisting of a heavy weight raised and dropped after the manner of a pile driver; in which small articles are forged from hot iron by means of dies, one fixed on the anvil, and the other mounted on a weight or tup which is drawn up and let fall from a height through guides.

Drop Hanger.—A class of shafting support, which is secured to the under side of a beam; an inverted pedestal. So called to differentiate it from the post hanger.

Drop Keel.—A centerboard, or shifting keel. A keel which projects below the outer skin of a craft.

Drop Oiler.—A sight feed lubricator, in which the oil is supplied in visible drops.

Drop Press.—A machine for embossing, punching, etc., consisting of a weight guided vertically, to be raised by a cord and pulley, sometimes worked by the foot, and to drop on an anvil; also called a drop.

Drop Table.—A contrivance for lowering heavy weights, or for running wheels from cars or locomotives.

Drop Tee.—A short piece of pipe having a lateral outlet, used to connect a line of pipe with a pipe at right angles with the line, and running *downward*, causing the water or steam exhaust, to drop down.

Drop Test.—A standard method of proving the strength of rails, axles, bars, etc., by letting a weight fall from a given height upon the object to be tested, the latter being suspended upon points at a stated distance from each other.

Drop Worm.—In machinery, a worm gear which can be dropped out of engagement with its wheel, either by hand or automatically. It is used on some types of milling and other machines.

Dross.—1. The scum or extraneous matter of metals, thrown off in the process of melting.

2. An incrustation formed on metals by oxidation; rust; crust of metals; waste matter; any worthless matter separated from the better part.

Drought.—Dry weather; a long period without rain.

Drove.—1. To dress with a broad edged chisel, said of stone work.

2. A stone mason's broad edged chisel.

3. A narrow channel for purposes of irrigation.

Drowned Tubes.—Those generating tubes of water tube boilers which discharge into the steam drum below the water level.

Drudge.—One who works hard, or labors with toil and fatigue; an unwilling or reluctant worker.

Drum.—1. Anything resembling a drum in form.

2. In cement manufacture, a cylinder heated within or without, through which the raw materials are conveyed to dry them, as it is impossible to grind them to a sufficient fineness if they are damp.

3. A short cylinder revolving on an axis, generally for the purpose of turning several small wheels, by means of belting passing round its periphery; called also pulley. In calico printing, a vessel in which fabrics are exposed to the action of steam, to fix the colors.

Drum Brake.—A brake for automobiles, etc., in which the frictional power is applied by clamping bands applied to the exterior surface of a drum.

Drum Shaft.—In hoisting engines, the shaft on which the *drum* revolves, it being the *main shaft* of the hoisting engine.

Dry.—To lose moisture; to become free from moisture or juice; to evaporate wholly; to be exhaled; said of moisture or a liquid.

Dry Air Blast.—An improvement in blast furnace operation, in which the air for the blast is first refrigerated so that it is freed from suspended moisture, then forced by the blowing engine through the usual stoves to heat it for the blast.

Dry Compression.—In refrigeration, when the ammonia is compressed without the addition of liquid ammonia, the superheat of compression being taken away by a water jacket.

Dry Dock.—A dock capable of being sealed by caissons or gates and then pumped dry, wherein repairs and inspection of the underwater portions of a vessel take place.

Dryer.—A kind of trap attached to the suction pipe of an ammonia compressor, through which the ammonia gas can be passed when necessary to take out any water that it may carry. Freshly burnt unslaked lime is ordinarily used for this purpose. Also called a dehydrator.

Dry Fining.—A process of polishing metals, when a fine surface is required; subsequently to the ordinary polishing, the article is finished upon a fine grained wheel without grease or paste.

Dry Gas.—In refrigeration, ammonia gas from which all watery vapor has been taken out.

Drying.—1. Adapted to exhaust moisture; as, a drying wind.

2. Having the quality of rapidly becoming dry and hard; as, drying oil.

Drying Oil.—An oil which either naturally or after its boiling with oxide of lead, absorbs oxygen from the air and dries up rapidly. Drying oils are used as a basis for many paints and varnishes.

Drying Stove.—In founding, a stove or oven used to dry cores and moulds.

Drying Tower.—A tower used to dry the raw materials for Portland cement before grinding, consisting of a kiln into which the materials are fed at the top and removed from the base, meeting a current of hot air forced from a furnace by means of a fan; the spent air, laden with moisture, escaping from a chimney on top of the tower.

Dry Kiln.—A term applied to a drying house or oven for lumber, in which it is exposed to heat to expel moisture.

Dry Measure.—The system of measure commonly used in the measure of dry, or non-liquid products—as, coal, salt, etc. The units of dry measure are the *pint, quart, peck and bushel*.

Dry Meter.—An instrument for measuring gas. The unit of quantity for gas is the cubic foot.

Dry Picking.—In paper making, the sorting of esparto to clean it of roots, dirt, etc., before boiling with caustic soda; the second sorting after boiling is known as wet picking.

Dry Pile.—In physics, a form of the Voltaic pile, constructed without the use of a liquid, affording a feeble current, and chiefly useful in the construction of electroscopes of great delicacy.

Dry Pipe.—A slotted or perforated steam collecting pipe within a boiler, insuring dryness.

Dry Plate.—In photography, a glass plate, covered with a film of silver iodide or bromide suspended in gelatine. These plates are exposed in the camera to the light reflected from the object to be photographed; where the light falls, the silver salt is more or less reduced to a *sub-salt* by the action of the light. On developing or placing the plate in a solution such as pyrogallie acid and ammonia, the sub-salt is reduced to metallic silver; to preserve this picture and prevent the undecomposed salts from blackening with exposure, the plate is fixed by immersion in a solution of hyposulphite of soda; this last process produces the negative from which a positive is printed on sensitized paper by the action of sunlight, or gas light according to the kind of sensitized paper used.

Dry Pressed Brick.—A brick compressed in a dry state in the mould, resulting in a superior finish. The objection of subsequent drying is avoided in the manufacture of these, but the additional preparation requisite in drying the clay and reducing it to a sufficiently fine and uniformly pulverized state, and the more expensive character of the machinery involved, add materially to the cost of manufacture.

Dry Puddling.—The conversion of white pig iron into wrought iron; the metal being worked in a pasty condition on the hearth of a reverberatory furnace. To puddle grey iron in this way, it is necessary to perform preliminary *refining*.

Dry Rot.—A decayed condition of timber in certain situations where it becomes brittle and crumbles to a dry powder; a decay affecting lumber, etc., occasioned by various species of fungi.

Dry Sand Moulding.—A foundry process wherein moulds are made of a mixture of old loam and rock sand, being dried before casting; used for making pipes or long and delicate castings.

Dry Steam.—Steam which contains no moisture. It may be either *saturated* or *superheated*.

Dry-stone.—In building, constructed of stone, without mortar; a dry-stone wall.

Dry Vat.—A vat or other receptacle for dry articles.

Dual Ignition.—In an automobile, an apparatus for igniting the engine charge, consisting of two independent electric ignition systems; one operating on current supplied by a battery and one on current from a magneto.

Dubbing.—A composition of fish and animal oils, preferably cod liver oil and tallow, used to soften leather articles such as driving belts and harness, also rendering them impervious to water. The use of dubbing prolongs the life of belts, permits them to run slacker and intensifies the grip on the pulley; in leather making, a mixture of fish oil and tallow.

Dubbing Tool.—A tool for paring down to an even surface.

Duck.—A species of coarse cloth or light canvas, used for small sails, sacking of beds, etc.

Duck Machine.—In mining, a simple form of air pump worked off the spear rods in a mine, to exhaust foul, or force in fresh, air.

Duct.—A flue or channel for fluids; a tube or pipe; a ventilating passage. A passage or conduit.

Ductile.—Easily drawn out; flexible; pliable. Material, as iron, is "ductile" when it can be extended by pulling

and remain extended after the force is removed. The greater the permanent extension, the more ductile the material.

Dudgeon Expander.—An instrument used in expanding the ends of boiler tubes where they project beyond the flue sheet.

Dull.—In machine work or carpentry, a term applied to the condition of tools where their cutting edges are worn off.

Dull Metal.—In a foundry, cast metal becomes *dull metal* when it is allowed to lose some of its heat; as, while carried in the ladle, and enters the mould in a rather thick condition. It makes stronger but less smooth castings than hot poured metal.

Dull Red Heat.—In blacksmithing, iron becomes *dull red* in color when it is exposed to a heat of about 1290°F.

Dumb Iron.—The forward extremity of the side bars on a motor car frame, generally provided with eyes for the attachment of the front end of the carrying springs.

Dumb Singles.—In silk manufacture, wound and cleaned strands ready for doubling.

Dumb Waiter.—A movable framework or small lift, used for carrying things from one floor to another.

Dumb Well.—A lined, dry well, excavated to receive some moving part of a machine or structure, as the balance weights of a drawbridge or hoist; the hydraulic cylinder of a lift, etc.

Dump.—1. A place where refuse is deposited.

2. A heap of worthless rock, slag, or rubbish.

3. To heap refuse in one spot.

Dump Car.—A truck car, the body of which is so constructed that the car can be partly overturned for the purpose of emptying it.

Dump Grate.—Any grate for a boiler furnace or stove, so constructed that by a mechanical device it will dump the clinkers and ashes.

Dune.—A low hill of sand accumulated by the winds on a sea coast.

Dunnage.—Fagots, boughs, or loose materials of any kind, laid on the bottom of a ship to raise goods above the bottom to prevent injury by water in the hold; or to provide a level foundation for stowage; also loose articles of merchandise wedged between parts of the cargo, to prevent rubbing and to hold them steady.

Duodecimals.—A kind of multiplication called also *cross multiplication*, in which the denominations proceed by twelves, as of feet and inches. It is employed chiefly by artificers in computing the superficial and solid contents of their work.

Duplex.—Double; twofold; working in two ways or by two parts at once; as, a duplex pump.

Duplex Air Gauge.—A pressure gauge having two pointers registering on the same dial, a red one showing the reservoir pressure, and a black one, that existing in the train pipe.

Duplex Air Pump.—A twin or double air brake pump, in which the air cylinders are compounded or compress the air in two stages, while the steam cylinders are each of the same size and not compound.

Duplex Escapement.—A peculiar kind of watch escapement, in which, the scape wheel having two sets of teeth, a double action takes place at each vibration of the balance.

Duplex Ignition.—A combination of two methods or means of effecting ignition of the explosive mixture in an internal combustion engine.

Duplex Lathe.—A lathe having two cutting tools which operate at once.

Duplex Milling Machine.—One with two head stocks so that each may operate upon the same work.

Duplex Pump.—A direct acting non-rotative steam pump, in which equal cylinders, either simple or tandem compound are arranged side by side, the piston rod of each engine being prolonged as the pump rod of the pump which it drives. The chief characteristic lies in the valve gearing, the slide valve of each pump being driven through an arrangement of levers and linkwork from the crosshead of its neighbor.

Duplex Slide Rest.—One fitted with two tool posts for taking two cuts off the same piece of work.

Duplex Watch.—One with a duplex escapement.

Duplicate.—That which exactly resembles or corresponds to something else; hence, a counterpart.

Duplicating Machine.—1. A machine that performs similar operations on two kinds of work at the same time.

2. One that produces duplicate copies or impressions.

Durable.—Lasting; enduring; not perishable; having the qualities necessary to sustain wear and use without deterioration.

Durability.—The power of resisting influences which tend to cause decay; lasting.

Duration.—The period of time during which anything continues; the length of time any operation or process lasts.

Durnze.—In mining, a set or frame support in a gallery; it consists of a crown (cap or collar), two side props (legs or arms), and a sole piece (foot-piece, sill, or sleeper).

Dust.—Fine, dry particles of earth, or other matter, so attenuated that it may be raised and wafted by the wind; that which is crumbled to minute portions; powder; fine sand.

Dust Apron.—A sheet of leather or waterproof fabric, placed horizontally underneath the machinery of an automobile to protect it from dust and splashing of mud.

Dust Cap.—A closely fitting metal protection, covering delicate machinery; as, in a watch, to protect it from dust.

Duster.—In paper making, a contrivance consisting of a rotating cage, covered with wire cloth, and rotating on an inclined axis, by means of which, the dust, etc., is shaken out of the rags fed into it.

Dust Explosion.—One caused by the presence of dust particles of a combustible, suspended in the air of a confined space.

Dust Filter.—A gauze screen or cap fitted to the inlet pipes of an air compressor to prevent the intake of dust with the free air.

Dust Guard.—In railroad service, a thin shield of wood, leather, vulcanized fibre or other similar material which is used on the inside of car or tender journal boxes to exclude dust, etc.

Dust Proof.—Said of various bearings or portions of mechanism, when they are provided with caps, covers or diaphragms in such a manner as to exclude the entry of dust.

Dust Proof Bearing.—One constructed with caps and guards of impervious material so that dust is excluded from the surfaces in contact; a necessary device with the moving parts of railway rolling stock, automobiles, and vehicles generally.

Dusty Gases.—A dangerous mixture, the cause of violent explosions in mines, flour mills and grain warehouses. Air dusty with coal dust, etc., which in itself is too small in quantity to induce explosibility becomes explosive on the addition of still smaller proportions of combustible gas.

Dutch Door.—In carpentry, a door divided into two parts, horizontally, so arranged that the lower part can be shut and fastened, while the upper part remains open.

Dutchman.—A piece "fitted in" to restore a worn part or to hide a defect.

Dutchman Sinker.—A small light sinker used in well boring, being attached above the jars in a string of tools, to give force to the upward stroke.

Dutchman Substitute.—A substitute in a string of well boring tools connecting the Dutchman sinker to the jars.

Dutch Metal.—An alloy composition of eleven parts copper to two of zinc, forming the most malleable of alloys.

Duty.—In mechanics, the work performed by an engine, especially a steam pumping engine, as measured in foot pounds for a certain quantity of fuel or dry steam consumed.

Duty of Pumps.—This indicates the measurement of the work performed by pumps. "Duty trials" are careful tests of the work done by the larger pumping engines for a certain quantity of fuel or dry steam consumed.

D Valve.—A name given to the common slide valve, as its sectional appearance is not unlike that letter.

Dwarf Pillars.—In machinery, small short pillars used to carry machinery; also to support the sides of a blast furnace.

Dwarf Signal.—A semaphore placed at a switch; it must not be more than two feet high.

Dyeing.—The art of coloring fabrics by steeping them in solutions containing coloring matters of vegetable or mineral origin, and properly fixing or making the color permanent.

Dynamical.—Pertaining to dynamics, or that branch of the science of mechanics which treats of forces that produce motion.

Dynamic Head.—In pumping water, a head usually expressed in pounds, per

square inch, representing both the pressure due to the elevation to which the water is pumped and that due to friction of the water in the pipes.

Dynamics.—That branch of mechanics which treats of the action of forces producing motion in bodies; the science of moving forces; opposed to *statics*.

Dynamite.—A high explosive composed of nitroglycerine, absorbed by some inert substance such as infusorial earth, sawdust, etc., in order to make it less dangerous.

Dynamo.—An apparatus for converting mechanical energy into electrical, based upon the principle that a copper wire rotated at right angles to the field of a magnet, sets up an electrical current.

Dynamometer.—An instrument for measuring the power of any prime mover. An apparatus for measuring power or force, either muscular or mechanical. Also called dynameter.

Dynamometer Car.—A carriage fitted with a traction dynamometer and various other recording instruments, placed next the locomotive, and used to test its performance in hauling a train.



E.—The fifth letter of the English alphabet; abbreviation for East, also for second class of merchant ship, rating at Loyds.

Ea.—Abbreviation for each.

Eads, James Buchanan.—

Born 1820, died 1887. An American engineer and inventor, for many years the authority upon the navigation of the Mississippi River. In 1856, he offered to contract with the United States Government to clean the channels of the Mississippi and three other great western rivers, and to maintain them so for a term of years, but the bill failed in the Senate. At the opening of the Civil War, he was engaged to build seven iron clad river boats for service on the Mississippi, and later he constructed iron gunboats, turret ships of the "Monitor" type, transports, and other vessels for the U. S. Navy. From 1867-74, he was employed in building the famous steel arch bridge across the Mississippi at St. Louis, one of the finest bridges ever built; his last great achievement was the deepening of the channel at the mouth of the Mississippi by a system of jetties, so that New Orleans became a leading export city; in 1884 he was awarded the Albert medal, being the first American to receive that honor.

Eagle Stone.—A species of clay iron stone of the size of a walnut or larger.

Ear.—1. The organ of hearing.

2. In mechanics, anything that has a general resemblance to the ear lobe, specifically a projecting piece, made to support objects; as, on vats and kettles, or to attach handles to, as on pails, or to hang objects by as on bills; any such piece serving a mechanical use.

Early Cut Off.—In steam engineering, a term relating to the ratio of the expansion of steam in an engine cylinder. Any cut off shorter than one-half the stroke may be properly termed early.

Earn.—To deserve, as by labor or service; to acquire by labor or performance, to deserve and receive, as compensation or wages.

Earth.—Material of which our globe is composed, such as soil, mould, rock, clay, dust.

Earthenware.—In pottery, a term applied to a class of cheap wares made from earthy substance, burned clay, etc.

Earthwork.—1. An embankment or construction.

2. The operations connected with excavations and embankments of earth in preparing the foundations of buildings, in constructing canals, railroads, etc.

Easing Gear.—An arrangement of levers etc., fitted to one safety valve of each boiler on a battery, whereby the engineer may ease the pressure when necessary.

Eaves.—The edges or lower border of the roof of a building.

Eave Trough.—A channel at the eaves of a roof for conveying away the rain water.

Ebb.—To flow back; to return; as, the water of a tide to the ocean; opposed to flow.

Ebonite.—Vulcanite or hard rubber; india-rubber mixed with sulphur and vulcanized at high temperatures. This renders it hard and black. It is a non conductor of heat and electricity, and is consequently much used for insulating portions of electrical machinery.

Ebony.—A species of hard, heavy, durable wood, from Madagascar and Ceylon, which admits of a fine polish or gloss. The heart wood is of a deep black color.

Ebullition.—The rapid production of vapor in the mass of a liquid, usually called boiling.

Eccentric.—A disk, having its axis of revolution out of its center of figure, used for obtaining a reciprocating or alternate motion from a circular one, especially in the valve gear of steam engines; an eccentric wheel. The motion derived is that of a crank having the same throw; it is a crank pin which is so large that it embraces its shaft and dispenses with arms.

Eccentric Bolts.—Those used to unite the two halves of an eccentric, or eccentric strap.

Eccentric Box.—A pillow block in which the journal is bored eccentrically to the brasses. By rotating the brasses in the

box, the shaft is displaced sidewise; this is useful for bringing spur friction wheels in or out of contact.

Eccentric Circle.—A term applied to the mechanical movement which constitutes the eccentric strap and connections; largely used to obtain reciprocal from rotary motion in steam engines, pumps, printing presses, etc.

Eccentric Crank.—In some types of valve gear, especially with locomotives which have outside motion, a crank of equal throw is substituted for the eccentric.

Eccentric Gear.—The whole apparatus of rod, strap, and other parts, by which the motion of an eccentric is transmitted; as, in the steam engine.

Eccentric Hook or Gab.—A hook shaped journal box on the end of an eccentric rod, opposite the strap, permitting the disconnection of the valve.

Eccentricity.—The distance from the center of a figure or revolving body to the axis about which it turns. In the eccentric used in engineering, this distance is equal to *one-half the throw*.

Eccentric Key.—A feather or key recessed into the shaft which drives the eccentric sheave, the latter being slotted in its larger half for the reception of the key.

Eccentric Rod.—The rod that connects an eccentric strap with any part to be actuated by the eccentric.

Eccentric Sheave.—The eccentric proper, which is commonly made in two halves, so that it can be placed upon the crank shaft or axle, the portions being united by bolts and cotters.

Eccentric Strap.—A hoop of metal, which may be brass, cast iron or steel, or else the two latter lined with either bronze or white metal. It encircles the *eccentric sheave* or cam, and communicates its motion to the rods and consequently, the valve gearing.

Ecliptic.—In astronomy, the great circle of the heavens which the sun appears to describe in its annual revolution; the circle to which longitudes and latitudes are referred in the heavens.

Economizer.—An arrangement of tubes placed in the uptake or flues of a boiler serving as a feed water heater, thus effecting economy by extracting further heat from the furnace gases after they have passed through the boiler itself and before they are discharged by the chimney. In connection with stationary boilers, the tubes of the economizer are vertical, they are kept clean by ring scrapers continually traveling up and down them, a small engine being provided for driving the scraper mechanism. In certain water tube boilers, the economizer consists of a series of elements similar to that of the boiler proper, so that it really constitutes a second boiler.

Eddy.—A current of water or air moving in a circular direction; a whirlpool.

Edge.—1. The sharp margin or boundary of a cutting instrument; that which effects severance.

2. The verge or border of anything, generally with an idea of abrupt ending.

Edge Moulding.—The process of forming an ornamental profile or sectional outline upon the edges of boards; either effected by especially propelled tools in a moulding plane, or by similar cutters disposed around a cylindrical cutter block and revolved in an edge planing machine.

Edge Runner.—A grinding mill, in which the stones run on edge within a pan or bowl; as, in a mortar mixer.

Edge Tools.—Cutting instruments used in the arts and handicrafts, more especially those used in woodworking, such as chisels, gouges, etc.

Edgewise.—Standing with edge upward; hence, endwise and sidewise have similar significations with reference to an end or side.

Edifice.—A building; a structure; chiefly applied to structures.

Education.—In steam engineering, the escape of exhaust steam from a cylinder.

Education Pipe.—The exhaust pipe from the low pressure cylinder to the condenser.

Education Port.—In steam engineering, a port through which the steam passes from the valves to the condenser.

Education Trunnion.—In steam engineering, the hollow gudgeon of an oscillating cylinder through which the exhaust steam passes on its way to the condenser.

E. E.—Abbreviation for "errors excepted."

Eface.—To remove from the surface; to erase or scratch out; to render illegible; to remove from the mind; to wear away.

Effect.—That which is produced by an agent or cause; consequence.

Effective.—That which produces a result, or contributes to a desired end.

Effective Heating Surface.—The part of the shell or tubes of a steam boiler which has water on one side and fire or hot gases on the other.

Effective Horse Power.—The amount of useful work which a steam engine is capable of performing. It is the difference between the indicated horse power and that required to drive the engine when it is running unloaded.

Efficiency.—In mechanics, the ratio between the useful work performed by a prime mover and the energy expended in producing it.

Eflux.—Out flow; the passing or flowing out of matter or a liquid in a stream. Also, the passing of time.

Effort.—In mechanics, a force which acts upon a body in the direction of its motion.

Effusion.—In chemistry, the escape or flow of a gas through a thin sheet or membrane into a vacuum.

Eft.—Soon; afterwards; quickly; again.

Eidograph.—An instrument for copying drawings on the same or different scale; a form of the pantograph.

Eight Bend.—In steam and gas fitting, a bent pipe having socketed and spigoted ends, whose length equals one-eighth of the circumference of the circle to whose radius the curve of the bend is struck.

Ejector.—An apparatus, consisting of a series of conical nozzles, whereby a jet of steam or compressed air propels a stream of liquid or fluid. The principle is the same as that of the *injector*, but the *ejector* always delivers into a space with but little pressure upon it, hence the differences in the design. Ejectors are fitted as emergency bilge pumps aboard ship, most warships having one in each compartment; and they are employed on railways to actuate the vacuum brake.

Elastic.—1. Possessing elasticity.

2. Having the power of stretching or

of resuming its original form upon the removal of a force which has occasioned compression, distortion or elongation.

3. A *textile fabric* in which is incorporated strands of fibers of india-rubber, thus conferring elastic properties upon it.

Elastic Fluids.—Those which have the property of expanding in all directions on the removal of external pressure; as, the air, gases, vapors.

Elasticity.—1. The property possessed by a solid body of resuming its original shape upon removal of any force which has modified its form by stretching, compression, twisting, etc. In a fluid this property permits it to assume its original volume after compression.

2. That physical property of the molecules of matter by which the holding of them in a state of strain involves work: the work necessary to maintain the strain being known as the stress. Stated broadly, as long as the strains in a material are proportional to the stresses, the body will resume its original shape as soon as the distorting effort is removed by virtue of its elasticity, but after a certain point the strains increase more rapidly than the stresses and permanent deformation or rupture ensues. Certain metals, such as wrought iron, copper and gold, have the further property of yielding to tensile forces so as to cause considerable alteration of shape without rupture. This modified elasticity is known as *ductility*.

Elastic Limit.—The greatest strain that a substance will endure and still completely spring back when the strain is released.

Elastic Nut.—In machinery, a form of nut by which compensation is made for the wear of the nut and its screw.

Elastic Washers.—In hydraulics, washers made of vulcanized india-rubber, as chiefly employed in pumping works.

Elbow.—A pipe fitting, consisting of a short bend through an angle of 90°, though others are obtainable which give an angle of 135°. Elbows are sometimes made with a sharp turn, being the intersection of two cylinders at right angles.

Elbow Spring.—A type of vehicle spring which is supported at one end, and bears the load at the other.

Electric Horse Power.—The electric equivalent of 33,000 minute foot pounds. It is calculated at 746 watts.

Electric Ignition.—Any system of exploding the charge in an internal combustion engine by means of an electric spark.

Electro Deposition.—The process of coating metallic articles with a film of another metal by the aid of electrolysis. The article to be treated is suspended in a bath containing an acid solution of the metal to be deposited, the positive wire of an electric battery or dynamo being attached to an *anode* or mass of the same metal as that in the solution; the negative wire is connected to the piece immersed. By the action of the electric current, the anode at the positive terminal is decomposed, and deposited upon the article attached to the negative pole.

Electrogen.—A device for preventing corrosion and pitting within boilers in connection with surface condensers. A large ball of zinc is suspended in the water space of the boiler, to which are soldered copper wires, these being led to any part of the boiler where pitting has commenced. It is necessary to scrape the steel absolutely bright to ensure good metallic contact, and the wires should be secured by bright studs, nuts and washers; the temperature being generally too high for solder. Galvanic action set up in the boiler now attacks the zinc instead of the steel, as the former metal is electro positive to the latter.

Electrolyte.—A compound decomposable by an electric current.

Electroplating.—The electro deposition of silver upon articles of baser but harder metals, for domestic use or purposes of ornament.

Electrotype.—A copper plate, from which an impression may be taken in printing, made from the original type by electrotyping. Such plates are generally employed where repeated editions of the same work are printed from time to time.

Electrotyping.—The reproduction of type, wood cuts, etc., in copper, by the aid of electro deposition. A cast is first taken of the set type in plaster of paris or other plastic material; this mould is next coated with black lead or bronze powder to give it a metallic surface, as the plastic materials are non-conductors; the mould is then subjected to the process of electro deposition, resulting in the formation of a film of copper on the prepared surface. The mould or cast is then removed from the film and the latter backed up with solder or type metal to render it strong enough for use.

Element.—In nature, one of the simplest parts or principles of which any thing consists; a kind of matter which has never been separated into two or more different substances.

Elementary.—Treating of elements or first principles of a science or art; introductory to a course of more advanced study.

Elementary Substance.—A substance which cannot be resolved into two or more component parts is called an elementary or simple body.

Elephant Boiler.—A type of stationary boiler, consisting of two parallel cylindrical shells with one larger shell placed between and above them, the upper one being connected to the lower by water legs or headers. There is a furnace in each of the lower shells, the products of combustion returning around them and finally passing to the chimney around the upper shell. An advantage claimed for this boiler, is the great height of water over the furnace crown.

Elephant Drawing Paper.—A sheet 28 x 23 inches.

Elevate.—To bring up from a lower place; to lift to a higher place; to raise; to lift up; as, to elevate a weight.

Elevation.—1. That which is raised up or elevated; an elevated place or station; as, an elevation of the ground; a hill.

2. A geometrical projection; as, of a machine, building, or other object, on a plane perpendicular to the horizon.

Elevator.—1. A lift or hoist consisting of a platform or cage, working between vertical guides, operated either through ropes driven by steam, electricity, compressed air, or water power, or by the direct thrust or lift of a hydraulic plunger.

2. A building for elevating, discharging and storing grain. See grain elevator.

3. A clamp for lifting well tubing. See casing elevator.

Elevator Boot.—In machinery, that part of an elevator in which the materials to be raised are dumped. It is a tank made in different styles from wood, steel or cast iron, in which the foot shaft and pulleys are placed, so causing the buckets to make a turn, and scoop up the coal, grain, or other materials.

Elevator Bucket.—In grain machinery, etc., a bucket made of different materials or in different designs to suit their work and fastened on a belt or chain or linked together to raise materials in bulk; as, coal, sand, grain, etc.

Elevator Casing.—Shrouding or tubing around the conveyor in an elevator, enclosing it from the boot to the head; this may be either in separate parts for each half of the belt or completely enclosing the whole.

Elevator Head, Leg and Boot.—The boxes in which the upper pulley belt and lower pulley respectively run in a

grain elevator. Elevator buckets or cups are attached at intervals to the revolving belt which elevates and by centrifugal force empties the grain at the top and returns empty for refilling.

Elevator Leg.—A boom or ladder of steel work, pivoted at the side of a marine grain elevator. A chain of buckets, similar to those of a ladder dredger, travel over the leg, and serve to empty cars, barges, etc.

Elevator Pumps.—Pumps specially adapted for use in connection with a hydraulic elevator.

Eleven.—Consisting of one more than ten. A cardinal number.

Eleventh.—The next in order after ten.

Elimination.—1. The act of expelling or throwing off.

2. Causing a quantity to disappear from an equation.

Eliminator.—A type of steam separator, in which the suspended moisture is separated from the steam by passing the latter through a vessel containing corrugated ribs and diaphragms.

Ell.—A cloth measure, formerly in use, supposed to be the length of the bended arm from shoulder to wrist. An extension at right angles to the length of a main building, giving to the ground plan a form resembling the letter **L**. A short, right angled pipe fitting used in connecting two pipes at right angles.

Ellipse.—A plane figure enclosed by a curved line, which is such, that the sum of the distances between any point on the circumference and the two foci is invariable. The ellipse may also be defined as a conic section obtained by a plane cutting a cone obliquely to its axis.

Elliptic.—In geometry, having the form of an oval or oblong figure, bounded by a regular curve, which corresponds to an oblique projection of a circle, or an oblique section of a cone. The greatest diameter of the ellipse is the *major axis*, and the least diameter is the *minor axis*.

Elliptical Arch.—A masonry arch built to a semi ellipse instead of a semi circle, to avoid excessive rise in the centre.

Elliptical Cylinder.—A cylinder whose cross section is elliptical instead of circular.

Elliptical Gear.—Toothed wheels made elliptical in form, thus permitting rotary motion to be transmitted which varies greatly from point to point during the rotation of the wheels. Used in connection with variable speed motions in special machinery.

Elliptic Arc.—A curve which is a portion of the circumference of an ellipse.

Elliptic Spring.—A combination of sets of springs, arranged in pairs so as to form an ellipse in appearance, being named double, treble, quintuple and the like from the number of pairs arranged side by side. Generally fitted to truck bolsters in railroad cars and engines.

Elliptic Trammel.—A device for producing ellipses. A rigid cross piece of wood or metal has two grooves at right angles to each other, studs sliding in these grooves guide a trammel so that its outer end describes an ellipse. The cross is fixed to the paper on lines corresponding to the major and minor axes of the ellipse, and the distance which each stud is placed from the center corresponds to the proportion of each semi-axis.

Elm.—A tree commonly planted for shade; as, the white elm. It produces a wood valued for its toughness and its durability under water.

Elongation.—1. The act of stretching or lengthening out, or the state of being lengthened out; protraction; extension; as, elongation of the fibers.

2. The amount to which a test piece of plate stretches, between two fixed points, due to a steady and slowly applied force, which pulls and separates it. This elongation is made up of two parts; one due to the general stretch, more or less, over the length; the other, due to contraction of area at or about the point of fracture.

Em.—In printing, the square of the letter *m*, used as the unit of measuring or estimating the amount of matter in a page, line, etc.; also, the amount of matter daily put in type by a compositor.

Embankment.—A mound, a bank, a dike; a mass of earth raised above the level of the surrounding land; built to protect lands from the inroads of the sea, etc., also used in the construction of roads, railways, canals, etc.

Embossing.—Ornament executed in relief, generally by stamping or hammering on the reverse surface. The term is

also applied to mouldings and ornaments raised upon a surface by carving or by impression of dies.

Embossing Press.—One used in embossing, more especially in stamping leather and similar materials into patterns and ornaments, or to raise a grain upon ordinary leather so as to imitate some special variety. This is done by taking electrotypes from the real leather, and then making dies from the electrotypes.

Embrasure.—A slant or beveling in the side of an opening to a wall for a window; the object of which is to make the inside profile of the window larger than that of the outside.

Embroidery.—Work in gold, silver, silk, or other thread, formed by the needle on cloth, stuffs, and muslin, into various figures and colors; ornamental decorations.

Emerald.—A precious stone of rich green color.

Emerald Green.—A very durable paint of a vivid light green color, made from the arseniate of copper.

Emergency.—Unexpected occurrence; an affair demanding immediate action.

Emergency Brake.—A device in use on railroads, whereby, even should the source of power be cut off, a powerful electro magnet puts the brake into action by means of current from the motors running as generators through the momentum of the car.

Emery.—This is a dark colored granular variety of *corundum*, which is the hardest substance found native, next to the diamond. The emery rocks are crushed into powder of varying degrees of fineness, which are used in that state as abrasive or polishing agents, or else consolidated with various binding materials into hones or wheels and discs for grinding purposes.

Emery Cloth.—Woven sheets of stout fabric first covered with glue and then sprinkled with powdered emery, graded according to the fineness of its particles.

Emery Grinder.—A grinding machine fitted with emery wheels.

Emery Paper.—Powdered emery attached to stout paper by glue.

Emery Paste.—A polishing material composed of grease combined with the finest emery powder.

Emery Wheel.—A solid wheel or disc composed of emery powder and a binding cement; used for grinding metallic surfaces or sharpening tools. Those made of the finest grade of powder and used for polishing are known as *emery buffs*.

Emery Wheel Dressing Tools.—A variety of tools are made for this purpose, generally consisting of a diamond mounted in a holder traveling upon a slide rest, or else a series of grooved or serrated circular cutters which take the place of the diamond. The application of such dressing tools is necessary to true the wheel or to remove a glazed surface which forms upon it and prevents its cutting.

E.M.F.—An abbreviation of electro motive force, the "pressure" which is exerted in applications of electricity.

Emission.—The act of emitting, giving or throwing out; as, the emission of light, the emission of smoke, and flame, or lava.

Employ.—1. To keep in service; to occupy.

2. To use; as, an agent, helper or representative.

Employé.—One employed by another.

Employer.—One who employs, in contrast to one who is employed.

Employment.—The act of employing or using; also, the state of being employed.

Emporium.—A place in which merchandise is collected, exchanged, or traded in; especially, a place of extensive commerce.

Empty.—Not filled; void of contents.

Empyreuma.—The disagreeable taste or odor produced when organic substances are decomposed by heat; as, in destructive distillation or when burned in closed vessels.

Empyrical.—1. Of or pertaining to combustion.

2. Having a combustible principle; as, coal.

Emulsion.—A mixture of liquids insoluble in one another, where one is suspended in the other in the form of minute globules; as, the butter fat in milk.

Enamel.—A substance of the nature of glass, but more fusible and more opaque, used for giving a highly polished, ornamental surface; as, enameled metal or enameled brick.

Enameled Brick.—A brick having a coating of opaque enamel on one or more sides.

Enameled Leather.—A kind of glazed leather, used in the manufacture of boots, shoes, and carriage decorations;—having a lustre somewhat less than that of patent leather.

Encastre.—In civil engineering, signifies a firm fixing of the end of a cantilever bridge or the ends of a beam in a wall or other support, making the beam or girder stronger than by simple support, by applying the principle of the *arch*.

Encaustic Tile.—A colored baked and glazed tile, used for ornamental paving or lining, etc. The coloring is frequently a sort of mosaic work.

End.—The extreme or last point or part of any material thing considered lengthwise; extremity; opposed to beginning.

End Connection.—A building term, denoting the method of attaching the base or capital of a column to the foundation upon which it stands or to the beam which it supports.

End for End.—One end for the other; in reversed order.

Endless Belt.—A belt which returns upon itself so as to have neither beginning nor end, passing over two or more pulleys to transmit power.

Endless Chain.—A chain whose ends have been united by a link.

Endless Rope.—A term applied to a rope with both ends joined together; often used in the transmission of power.

Endless Rope Engine.—In steam hoisting engineering, an engine on whose drum a cable is wound and unwound at the same time. They are used on cable railways.

End Link.—In a length of chain, a larger or plain link fitted at either end for connection by means of a shackle or clevis to any other part or piece.

End Milling.—Milling by the aid of a crown cutter, or one in which the cutting teeth are formed radially upon the circular end of a cylinder. This type of cutter is much used on nut finishing machines, and has the advantage of not affecting the depth of cut, if the cutter is slightly out of true, as every cutting edge must of necessity pass over every part of the face operated upon.

Endorsement.—That which is written on the back of a note, bill or other paper; as, a name or order for, or a receipt of payment. Written also indorsement.

End Piece.—A cross timber or sill at the end of a rectangular wooden framework, specifically in a freight car, or in the timbering around a mine shaft.

End Plates.—A pair of discs, used to turn crank shafts in the lathe. A hole in each plate receives the shaft, which is further gripped by set bolts, and other centers are made in the disc to coincide with the axial line of each crank pin, thus either crank pin or the body of the shaft may be turned, when the end plates are properly adjusted, according to which set of centers are placed on those of the lathe.

End Play.—Movement endwise, or room for such play or movement.

Ends.—In textile manufactures, the *warp threads* as enumerated in specifying the weave of the fabric. In similar manner the *weft* or filling threads are denominated *picks*. A weave is specified as so many ends and so many picks, the former being arranged for by the beaming of the warp, the latter taken care of by the change wheels actuating the shuttle feed.

End Sill.—In locomotive work, a transverse member of a tender framing, uniting the ends of all the longitudinal sills. If projecting beyond the sheathing, it is known as an outside end sill, if flush, is termed an inside end sill. The English equivalent is headstock.

End Thrust.—The lengthwise thrust of a shaft in or upon its bearings.

End Thrust Box.—A device used to take up end play on shafts in connection with friction cones. A stepped bearing is screwed within a pillow block, and rotation of this bearing through a small arc pushes the two parts of the cone closer together endwise.

Endurance.—The capacity of a material to resist stresses, especially those known as live loads, where rapid alternations of forces take place.

End View.—In architecture, a view on a drawing showing the end of a structure, as distinguished from its side view.

E.N.E.—(Nautical) East-North-East.

Energetics.—That branch of science which treats of the laws governing the physical or mechanical, in distinction from the vital, forces, and which comprehends the consideration and general investigation of the whole range of physical phenomena.

Energy.—Capacity of acting, operating or producing an effect, whether exerted or not; force; vigor; strength; spirit.

Eng.—Abbreviation for England, English.

Engage.—To interlock with another part; as, the teeth of geared wheels with each other, or a rack with its pinion.

Engine.—A compound machine or mechanical contrivance by which any physical power is applied to produce a given effect. The term engine is more commonly applied to massive machines, or to those of great power, or which produce some difficult result. It takes, in composition, other words, designating either the source of power as steam engine, air engine, calorific engine, or the purpose to which it is applied; as, fire engine, pumping engine, locomotive engine; or some peculiarity of construction, operation, or use; as, single acting or double acting engine, high pressure or low pressure engine.

Engine Blocks.—In steam engineering, large wooden blocks acting as a foundation or used to elevate the engine to a higher level than the floor or ground; as, in hoisting engines employed on construction work.

Engine Counter.—A device which records by wheel combinations the revolutions of an engine or machine where it is necessary or convenient to know the number of rotary turns within a specified time. Whatever number of dials or wheels there may be, the right hand figure represents the units, the second figure the tens, etc. This ingenious mechanism is capable of various applications relating not only to the number of revolutions the engine has made, but telling how many miles a steamer has gone.

Engine Driver.—The person in charge of a locomotive, by analogy with the driver of the stage coach, displaced by the railway. In England—an attendant in charge of a steam engine, differing from an engineer in that the latter has to serve a pupilage or apprenticeship before being granted a certificate. Usually called *engineer*.

Engineer.—This word has a comprehensive meaning and is derived from the word, ingenious. An engineer is a man who can design, construct and finally operate machinery.

Engineer in Chief.—The head of the Bureau of Steam Engineering in the United States Navy. He has the relative rank of Commodore.

Engineering.—1. The science and art of making and using engines and machines.

2. Designing and constructing public works, or the like.

Engineer's Examinations.—A written and oral examination of candidates for engineer's certificates or licenses to ascertain the extent of their qualifications or their competency for the position of engineer.

Engineer's License.—An annual permit granted in certain cities to stationary engineers; the license relates to a particular plant, and must be renewed from year to year.

Engineer's Signal Code.—In railroad practice the sign **O** means a short, quick sound, while the dash (-) means a long sound.

Apply brakes, stop.....	O
Release brakes, start.....	O O
Back.....	O O O
Highway crossing signal.....	- O O or O O - -
Approaching station, - blast lasting 5 seconds.	
Call for switchman.....	O O O O
Send back flagman.....	O O O O O
Call in flagman.....	- - - - -
Cattle on track.....	- - - - -
Train has parted.....	O
Railroad crossing, same as approaching station.	
For fuel.....	O O O O O
Bridge or tunnel warning.....	O O -
Fire alarm.....	O O O O O
Will take side track.....	- - - - -

Red signifies danger; green signifies caution, go slowly; green and white signifies stop at flag stations for orders, for passengers or freight. One cap or torpedo on rail means stop immediately; two caps or torpedos means reduce speed immediately and look out for danger signal.

Engine Frame.—The skeleton or structure of a locomotive, to which the other portions, boiler, cylinders, wheels, etc., are attached, so that they may maintain their proper relations with each other, and the stresses due to the locomotive's dual capacity of machine and vehicle may be properly distributed.

Engine Lathe.—A manufacturer's term for a good class screw cutting lathe, such as is generally employed in producing

the smaller parts of steam engines; the ordinary type of lathe without the special attachments or arrangement which cause other classes to be differentiated as *pit lathe, wheel lathe, turret lathe, &c.*

Engine Pits.—These are trenches between the rails in a roundhouse or running shed, giving access to the underneath parts of the locomotives.

Engine Room.—That part of a steam plant allotted to the steam engines, used in distinction to the boiler room.

Engine Runner.—One who drives or manages a locomotive; an engineer.

Engine Seatings.—In marine engineering, the structures incorporated into the framing of the ship to afford a foundation for the propelling machinery, usually consisting of tank-like or cellular constructions spread over a number of frames, in connection with heavy reverse frames and web plates.

Engine Shed.—A roundhouse, running shed or depot where locomotive engines are "stabled" between trips. Also, in textile manufactories, the engine room.

Engine Sized.—In paper making, denotes that the sizing has been incorporated with the pulp in the beating engine.

Engine Truck.—The swivelling carriage or bogie supporting the leading end of a locomotive.

English Bond.—The strongest form of bond for brickwork, in which a header course alternates with a stretcher course.

Eng'r.—Abbreviation for engineer; engineering.

Engraving.—1. The art of cutting stones, metals, and other hard substances, and representing thereon figures, letters, characters, and devices; especially the art of producing figures or designs on metal, etc., by incision or corrosion, for the purpose of being subsequently printed on paper.
2. An engraved plate.

Enlargement.—The act of increasing in size; further extension; expansion.

Enlarging Drill.—A combination of drill and reamer, being a twist drill formed with double flutes, so as to present three cutting edges.

Enricher.—Something added to a substance in order to strengthen a certain quality; as, oil vapor is added to gas to enrich it, that is, to bring up its candle power.

Enrichment.—The act of making rich, or that which enriches; increase of value by improvements; embellishment.

Entablature.—In building, the superstructure which lies horizontally upon the columns.

Entangle.—To twist or interweave in such a manner as not to be easily separated; to make tangled.

Entasis.—In architecture, a slight convex swelling of the shaft of a column.

Entering Tap.—In machinery, a tapered tap, making an opening in which a pointed screw has easy entrance.

Entering Tool.—A wood carver's chisel, of a firmer shape, but with a double bend near its edge, permitting it to work below the surface of the panel; also known as grounder.

Entrance.—That by which any place is entered; as, a door or gate.

Entrance of a Ship.—1. A report by the shipmaster to the port authorities, of the arrival of his vessel, as legally demanded.

2. The underwater forward part of a ship, or forebody; the opposite to the vessel's run.

Entropy.—In thermodynamics, a certain property of a body, expressed as a measurable quantity, which remains constant if no heat enters or leaves the body, whilst it does work or alters its volume, but which increases or diminishes should a small amount of heat enter or leave.

Enumeration.—The reading of numbers already written.

Envelop.—To cover; surround, invest or enwrap; to enfold with a surrounding medium; to wrap up or enclose within a cover or casing.

Envelope.—1. A sealed cover in which communications are enclosed for passage through the mails.

2. The exterior curved surface of a solid; as, of a cylinder or sphere.

Envelope Machine.—A machine for making letter envelopes. It cuts, folds, gums and presses the edges.

Eocene.—In geology, the lowest subdivision of the tertiary rocks. The name is derived from words signifying the dawn, as its fossils contain a small percentage of molluscs still in existence, and hence shows the beginning of the present inhabitants of the earth.

Epicyclic Gear.—The same as planetary gear, in which one or more pinions are in contact with teeth inside the circumference of a spurwheel.

Epicycloid.—A curve generated by a point in the circumference of a circle when rolling within the circumference of another circle.

Epsom Salts.—The crystalline hydrate of magnesium sulphate, found naturally in Epsom spring waters.

Equaling File.—A flat file of thin section, usually parallel on all four sides, and sometimes furnished with one safe edge.

Equality.—The state of exact similarity between two or more bodies; the possession of identical weight, bulk, and dimensions.

Equalize.—To make equal; to cause to correspond, or be like in amount or degree, as compared.

Equalizer.—1. Any appliance in the nature of a balance or lever, by means of which the forces on two or more parts of a structure are equalized or proportioned to each other; specifically, an equalizing beam or lever as used to correct the various springs of a locomotive, applied to make the loads on each wheel uniform or proportionate to the lever arms.

2. In refrigeration, the vessel in which the strong liquor coming from the absorber takes up the heat from the weak liquor going from the generator to the absorber; usually called the heat exchanger.

Equalizer Fulcrum.—A block or heel set upon the locomotive engine frame, so placed that the equalizing beam may balance upon it.

Equalizing Beams or Bars.—Levers pivoted on the framing of a locomotive, and connected at either end to the hangers of bearing springs on different axles. They are designed to secure uniformity of load on the various driving wheels and flexibility of motion.

Equation.—In mathematics, an expression of equality between two algebraic quantities or sets of quantities, the sign being placed between them.

Equator.—1. A great circle surrounding any sphere, midway between its poles; or that part of any body possessing poles which lies equidistant from those poles.

2. The great circle about the earth's circumference, at every point equidistant from the North to South poles, which divides the Northern from the Southern hemisphere.

Equiangular.—Said of a triangle, when all its angles are equal to each other, it naturally follows that its sides are equal to each other.

Equiangular Triangle.—One having its three angles equal.

Equidistant.—Situated at equal distances from the same point or thing.

Equilateral.—A figure with equal sides.

Equilateral Triangle.—Having all the sides equal.

Equilibrium.—A state of being balanced; equality of weight or force.

Equilibrium of Forces.—In mechanics, a counterpoise or state of rest produced by the mutual counteraction of two or more forces.

Equilibrium Ring.—In steam engineering, a metallic ring enclosing a space on the back of the valve equal in area to that of the exhaust port, into which space, therefore, no steam can gain admittance.

Equilibrium Valve.—A balanced valve; as, in a steam engine.

Equinoctial.—Occurring at or near the time of an equinox, or the time at which the sun crosses the equator, about March 21st and September 22nd, when day and night are of equal length; as, an equinoctial storm.

Equinoctial Line.—The equator.

Equip.—To furnish or fit out; as, the steamer was equipped for two years.

Equipment.—The collective designation for the articles comprising an outfit; as, a railroad equipment (cars, locomotives, etc.) for carrying on business.

Equipoise.—Equality of weight or force; a state in which the two ends or sides of a thing are balanced.

Equivalent.—That which is equal in value, weight, or force; as, to offer an equivalent for damage done.

Eraser.—One who, or that which erases, especially, a sharp instrument or a piece of rubber used to erase writings, drawings, etc.

Erecting Shop.—That department of an engine works where the parts and details are assembled and erected into the finished machine, the various pieces being received in a more or less finished state from machine and fitting shops. The extent of the operations performed vary with the shop organization.

Erection.—In civil and mechanical engineering, the act of erecting, or raising upright; the act of constructing; as, a building or a wall, or of fitting together the parts of a machine or a steel frame structure.

Erector.—A skilled mechanic employed in assembling together the various parts of a machine. Most usually, an artificer who builds or erects steam engines, from wholly or partially completed details, in the factory, or who subsequently installs them in the place of their ultimate employment.

Ericsson, John.—Born 1803, died 1889. A Swedish-American engineer. Before coming to the United States he spent a number of years in England engaged upon inventions, among which he designed a steam boiler with artificial draughts (1829), a steam fire engine, a caloric engine (1833), the screw propeller (1835); he came to America in 1839, and in 1841, he constructed the first warship with propelling machinery below the water line and using a screw propeller, but his chief fame is due to his building the famous turret iron-clad, the "Monitor," which forever established the use of metal in warship construction to the abandonment of wood.

Erosion.—A wearing away.

Error.—A mistake, fault or blunder. In mathematics, the difference between the approximate and the true result of a computation.

Eruptive.—A geologic term applied to those rocks which have been formed in a molten state, such as lava and trap.

Escape.—In mechanics, leakage or outflow; as, of steam or a liquid.

Escapement.—In watch and clock making, the mechanism which intervenes between the motive power and the regulator; causing an intermittent impulse to be given to the latter.

Escape Pipe.—A pipe for carrying away steam; as, that which escapes from a safety valve.

Escape Valve.—A relief valve, a safety valve.

Escape Wheel.—The wheel of an escapement; as, of a watch.

Escutcheon.—1. A thin metal plate which guards or finishes a key hole.

2. That part of a vessel's stern on which her name is written.

Escutcheon Pin.—A small ornamental brass nail, with snap or button head, used to fasten escutcheons on doors, drawers, etc.

E. S. E.—Abbreviation for East-South-East.

Esparto.—A feathery tufted grass growing to a height of three or four feet in clumps, some three feet in diameter. It is indigenous to Spain and Algeria, and its gray green convoluted leaves, often three feet long, are collected for their fibrous material, which is used in the manufacture of paper, and for cordage, as it will float on water.

Essential.—Important in the highest degree; indispensable to the attainment of an object.

Essential Oil.—A volatile oil obtained by distillation of plants, fruits and flowers, and having the characteristic odor of the plant from which it is extracted, as the oil of laurel, the oil of turpentine, etc.

Establish.—To originate and secure the permanent existence of; to found; to institute; said of an institution.

Establishment.—A permanent manufacturing or commercial organization.

Ester.—In chemistry, a compound of an alcohol with an acid. A general method of preparing esters is to mix the alcohol and acid together and act upon the mixture with a dehydrating agent, such as sulphuric acid or zinc chloride.

Estimate.—A valuing or rating without actually measuring, weighing or the like; to compute; to calculate; to reckon.

Etching.—The process of eating away or corroding a metallic surface by means of a mordant. In the arts, a steel or copper plate is covered with a resisting coat of wax: the picture is drawn on the wax by means of a needle, the scratches being sufficient to remove the wax and lay the metal bare. The completed plate is then immersed in an acid bath, which eats away the exposed metal.

Ether.—A colorless volatile liquid, distilled from a mixture of sulphuric acid and alcohol, and hence sometimes known as sulphuric ether. It is used as an anæsthetic, by inhalation, being safer than chloroform; or to cause local refrigeration and anæsthesia by spraying and evaporation. It is a solvent for most fatty and resinous substances, caoutchouc, guncotton, etc., and serves as a refrigerating agent similarly to ammonia. Engines have been built using the vapor of ether similarly to steam.

In the early history of artificial refrigeration, ether was used in ice machines, for which purpose it possesses certain important advantages, but these are more than outweighed by its inflammability and liability to explosion when mixed with air.

Ethyl Alcohol.—The ordinary alcohol of commerce ($C_2 H_5 O H$) as contained in proof spirits, wines and beers. The various forms are obtained by the fermentation of sugar (generally under the influence of yeast), the spirits are obtained by the repeated distillation of the watery products of fermentation.

Eucalyptus.—A species of tree called also gum tree, which produces resinous gums, oils, tars, dyes and tanning material, and is valued by builders and millwrights.

Eudiometer.—An instrument used for the measurement of gases, also frequently employed to determine the purity of air.

Evans, Oliver.—Born 1755, died 1819.

An American engineer and inventor. Early in life he conceived the idea of utilizing steam power to drive vehicles, but was deterred by poverty from working out his plans; meanwhile he invented a machine for making wire card teeth, used in carding wool and cotton, and made improvements in processes of flour milling, which led to revolutionizing the manufacture of flour. In 1801 he built a successful steam engine for grinding plaster, and in 1803 he became a regular builder of engines, making the first practical steam road wagon in 1804; he invented the first high pressure steam engine and the first steam dredging machine used in the United States; he is sometimes called the "Watt of America."

Evaporate.—To convert from a liquid or solid state into gaseous, by the agency of heat, especially by the slow agency of natural heat; to dissipate in vapor or fumes.

Evaporating Pans.—1. An arrangement of shallow pans in series, for concentrating liquids, particularly in sugar manufacture, for evaporating water from cane juice.

2. A device for cooling a ventilation system by passing the air supply over an arrangement of shallow pans, on which water is permitted to drip and evaporate, consequently lowering the temperature.

Evaporation.—The process by which any substance is converted from a liquid or solid state into and carried off in vapor.

Evaporative Condenser.—A type of condenser for use where the supply of cooling water is limited, where a thin stream or spray of water falls over the outside of stacks or coils of tubes through which the vapors to be condensed pass.

Evaporative Efficiency.—The measure of the efficiency of a boiler in evaporating water as compared with the theoretical value of a certain amount of fuel. Commonly expressed as so many pounds of water at $212^{\circ}F.$, evaporated into steam at the same temperature, the unit of fuel consumed being one pound of dry coal.

Evaporator.—1. An apparatus for condensing vegetable juices, or for drying fruit by heat.

2. An apparatus, heated by steam coils, used on shipboard to distill fresh feed water from salt. Under good management, tight triple expansion engines, will require about $\frac{1}{2}$ ton of water daily (say 130 to 150 U. S. gallons), for each hundred indicated horse power, to replace that lost through glands, joints and blowing off.

Even Pitch.—In machinery, a screw is said to be of even pitch when the number of threads per inch in it either corresponds with, or is some aliquot part of the pitch of the threads of the leading screw of the lathe in which it is being cut.

Evolution.—In arithmetic and algebra, the extraction of roots; the reverse of involution.

Ex.—Abbreviation for examined; example; exception; export.

Exact.—Precisely agreeing with a standard, a fact, or the truth; as, the exact sum; the exact time.

Examination.—1. The act of examining, or state of being examined; a careful search or inquiry.

2. A process prescribed or assigned for testing qualification; as, the examination of an engineer for promotion.

Example.—An instance serving for illustration of a rule or precept, especially a problem to be solved; as, an exercise in the application of the rules of any study or branch of science; as, the principles of trigonometry, explained by examples.

Excavate.—To hollow out; to form a cavity or hole in; to make hollow by cutting, scooping, digging or the like; as, to excavate a cellar.

Excavation.—1. A hollowing out, especially of the ground.

2. The act of digging in the earth on a large scale, the term being generally associated with open air workings.

Excavator.—A machine for removing earth and making excavations. Three broad types are in use: 1, the *steam navy* or *steam shovel*, which consists essentially of a huge scoop operated by a crane; 2, the *grab* operated by a crane, in which closing buckets of varied shapes grasp soft material between their jaws; 3, a modification of the *bucket ladder dredger*.

Exceed.—1. To pass or go beyond; to proceed beyond the given or supposed limit.

2. To surpass; to excel; to transcend.

Excelsior.—Fine cut, curled wood shavings, used for many purposes; as, in upholstery, or a filtering medium in feed water filters and gas producer purifiers, also, as stuffing for packing cases, etc.

Exception.—1. An objection; dissent; disapprobation.

2. That which is excluded or separated from others in a general statement or description.

Excessive.—Exceeding that which is right or just.

Exchange.—To part with for a substitute; to give and receive reciprocally; to swap.

Exclude.—To shut out; to hinder from entrance or admission; as, to exclude a crowd from a room or house.

Exclusive.—Possessed and enjoyed to the exclusion of others; as, exclusive membership; having the power of preventing entrance.

Executor.—A person nominated in the will of another, to carry out the wishes of the testator. Businesses, manufactories and estates have frequently to be carried on or administered by the executors of their former owner.

Exhaust.—1. To empty of anything; to deplete.

2. The passing of steam or other working fluid from a cylinder to the atmosphere or the receiver of the next successive cylinder, after it has pushed the piston to the end of its journey in one direction.

Exhaust Box.—A muffler or silencer on an automobile.

Exhaust Cams.—The cams or sheaves actuating the exhaust valves of various American paddle engines.

Exhaust Cavity.—The recess or hollow within the body of an ordinary slide valve, which affords passage from the steam ports to the exhaust port in the cylinder during the exhaust period.

Exhaust Edges of Slide Valve.—Enclosing lines of the central or exhaust cavity, which regulate the emission of steam; adding lap on these edges, that is, prolonging them towards the center, shortens the duration of exhaust and increases compression or cushioning.

Exhauster.—A rotary pump used in gas works to suck the gas through the condensers, scrubbers and purifiers, and deliver it into the gas holder. The exhauster prevents the pressure on the holder from blowing gas back into the retorts, and is responsible for the pressure in the mains, the holder serving as an accumulator only.

Exhauster Room.—That department of a gas works containing the exhausting engines; all pipes lead to it from the generating departments, and conduits from it run to the various gasometers.

Exhaust Fan.—An air propeller used to create a vacuum; the opposite to blowing fan.

Exhaust Head.—An apparatus placed upon the top of a steam exhaust pipe to prevent the condensed steam from being blown about.

Exhaust Injector.—One operated by the exhaust steam of an engine.

Exhaust Lap.—Also known as *inside lap*; extension of the exhaust edges of a slide valve to promote cushioning by closing the exhaust early.

Exhaust Line.—A steam indicator term; counter pressure or back pressure line in a diagram, showing the steam pressure between the commencement of the return stroke and the beginning of compression.

Exhaust Nozzle.—In a locomotive, the orifice through which the steam escapes to the atmosphere, creating the draft as it does so. Sometimes made with an adjustable orifice so the force of the draft can be regulated.

Exhaust Passage.—Ports or chambers cast within the body of a cylinder of a steam engine which are traversed by the exhaust steam.

Exhaust Pipe.—In steam engineering, the pipe which leads away the spent steam from an engine cylinder.

Exhaust Port.—The central port in the valve face of a cylinder, through which the steam finds egress from the cavity of the slide valve into the exhaust pipe.

Exhaust Steam.—That which is allowed to escape from the cylinder after having been employed to produce motion of the piston.

Exhaust Steam Heating.—A system of warming buildings by means of waste steam.

Exhaust Stroke.—The return stroke of an internal combustion engine, immediately following the explosion stroke, during which the products of combustion are expelled from the cylinder.

Exhaust Valve.—One or more independent valves fitted to those types of engines in which separate ports are provided for exhaust and admission.

Ex Nihilo, Nihil Fit.—A phrase, literally meaning "From nothing, nothing comes", or that there is no effect without a cause.

Exp.—Abbreviation for express, export.

Expanded Metal.—A material used in reinforcing concrete for walls, partitions, conduits, etc. Thin sheets of mild steel are placed upon edge and with one operation the metal is slotted and drawn out into a sort of network, the arris of each opening being turned practically at right angles to the original plane. The expansion varies from six to twelve times the original length without alteration in its width.

Expander.—An instrument for tightening the tubes of boilers in the tube plate holes. It consists essentially of revolving rollers which are rotated and forced apart by a taper pin.

Expanding Bit.—One with a pair of adjustable cutting points which can be set apart to any desired distance (within limits), thus permitting variations in size of holes drilled, and also giving a number of diameters for one cutter.

Expanding Brake.—A drum or pulley brake in an automobile, upon which the braking force is exerted by shoes forced outwardly against its inner rim.

Expanding Chuck.—A chuck usually holding the work from its bore, and capable of expanding to accommodate a slight variation of work-diameter.

Expanding Clutch.—A friction clutch which is engaged by forcing shoes radially against the inner rim of a disc, cone, or drum, generally the interposition of a toggle joint.

Expanding Drill.—A drill similar to an expanding bit, which see. The cutters may be spread apart at a desired depth thus increasing the diameter of the bored hole below that point.

Expanding Mandrel.—A mandrel whose diameter may be varied, usually by means of adjustable jaws or pieces.

Expansion.—1. The act or process of increasing in bulk; dilatation of any substance through its particles becoming more widely separated from one another by the influence of heat. With gases, the property of expansion is characteristic, that is, any gas admitted into a closed chamber will immediately dilate until it has completely filled the chamber, sometimes becoming extremely rarefied in the process. With open ports the expansive energy of steam acts from the water in the boiler as its fixed point of fulcrum, but after it is "cut off" it acts from the fixed ends of the cylinder.

2. That portion of the cycle of a heat engine in which the fluid gives off the initial energy stored in it, while being gradually expanded down to the point at which it is rejected from the engine.

Expansion Bolt.—A bolt having a split case or sleeve which is either conically bored or else notched, a male cone or V point on the bolt itself fitting into the case or sleeve. As the bolt is tightened up, the wedge or cone expands the split sleeve around it, thus giving a secure grip.

Expansion Coil.—The series or coils of iron pipe placed in a refrigerating box or brine tank, in which the ammonia vaporizes after passing through an expansion valve.

Expansion Curve.—The curved expansion line of an indicator diagram, being approximately a *hyperbola*.

Expansion Cylinder.—The cylinder, within a dry air refrigerating machine, in which the previously compressed air, after cooling in the condenser and parting with its latent heat, is expanded to its normal tension; during expansion, the air performs work upon the piston, its admission being controlled by valves like those of a steam engine, and thus returns some of the work done upon it in compressing.

Expansion Joint.—A device used in connecting up long lines of piping, etc., to permit linear expansion or contraction as the temperature rises or falls. The usual pattern consists of a sleeve secured to one length of pipe, which works within a stuffing box attached to the next length.

Expansion Line.—The curve traced by the pencil of a steam engine indicator corresponding with the gradual fall of pressure in the cylinder during expansion; the line approximates to the curve known as the *hyperbola*.

Expansion of Steam.—1. That repellent force imparted to water by heat which causes each particle to repel and antagonize and drive to the greatest possible distance every other particle of the mass; it is impossible for steam to exist without heat.

2. That portion of the stroke of a steam engine in which the steam supply is cut off by the valves, and continues to perform work upon the piston, accompanied by increase in volume and consequent decrease in pressure. By this means, a greater proportion of the energy stored in the fluid is recovered as useful effort.

Expansion Parts.—In a locomotive, checks or guides affixed to the frames which hold the firebox in place, whilst permitting longitudinal motion through expansion or contraction.

Expansion Pipes.—In cold storage, those pipes within the refrigeration chambers in which the ammonia or other agent changes into a gas under release of pressure, drawing heat in the process from the surrounding air.

Expansion Plate.—A vertical steel plate placed underneath the boiler of a locomotive, at certain positions, to assist in supporting it, and possessing sufficient elasticity on account of its thinness to yield to the longitudinal movement due to expansion; also termed expansion knee.

Expansion Pulley.—One that is capable of being enlarged or reduced in diameter by expansion of its rim from the center or by contraction of the same, thus permitting a constant grip on a belt as it works slack, or giving various rates of speed with the same pulley.

Expansion Ring.—A hoop or ring of U section used to join lengths of pipe together so as to permit of expansion; as, the well known Bowling hoop for boiler furnace flues.

Expansion Tank.—In steam heating, an apparatus for heating by hot water. The supply cistern is increased in capacity beyond that necessary for actual supply, in order to allow for the expansion of water due to heat, without the risk of overflowing.

Expansion Trunk.—In bulk petroleum steamers, a self trimming tank continued fore and aft over the whole of the cargo tanks and subdivided with them. It provides for expansion consequent on increase of temperature, and keeps the main tanks full, preventing surging.

Expansion Valve.—A cut off valve, to shut off steam from the cylinder before the end of each stroke. In *refrigeration*, a regulating valve adjustable within narrow limits which controls the escape of the refrigerant from a liquid state under pressure, to a gaseous state.

Expedition.—1. Speed; quickness.

2. A sending forth or setting forth for the execution of some object of consequence; an important enterprise, undertaking, or attempt at some distance; an excursion by a body of persons for a valuable end; as, a naval or scientific expedition.

Expense.—That which is paid out, expended, consumed.

Experience.—Personal trial and experiment; continued and varied observation. Practical acquaintance with any matter by personal observation or trial of it, or by feeling its effects.

Experiment.—A practical test. A trial deliberately instituted; an act or operation undertaken in order to discover something unknown, or in order to test, establish, or illustrate some allied or known truth.

Expert.—One who has skill, experience, or peculiar knowledge on certain subjects of inquiry in science, art, trade, or the like.

Explanation.—The act of explaining, or interpreting; the act of clearing from obscurity and making intelligible.

Explicit.—Distinctly stated; plain in language; open to the understanding; clear; not obscure or ambiguous.

Explode.—To drive out with violence and noise; as, by powder.

Exploder.—That which causes an explosion. In *blasting* the contrivance which generates the igniting spark for the explosion of dynamite, gunpowder, etc.

Exploit.—A deed or act; a great or noble achievement; as, the building of a great steamship.

Exploitation.—The act of organizing and operating an industry; making use of; the act of utilizing for self interest alone.

Explosion.—A bursting with violence and loud noise, due to a chemical action which causes the sudden formation of a great volume of expanded gas; as, in the explosion of a steam boiler.

Explosive.—A chemical substance, solid or liquid, one of the constituents of which is instantaneously converted into gas on ignition or detonation, exerting enormous pressure.

Explosive Engine.—In machinery, an engine the piston of which, in the cylinder, is moved by a chemical action which causes the sudden formation of a great volume of expanded gases; as, in a gas engine. Also called *internal combustion engine*.

Explosive Mixture.—1. A finely subdivided substance suspended in the atmosphere, which deflagrates and undergoes chemical change with intense rapidity, accompanied by great heat and the evolution of gaseous products occupying a much greater volume than the original mixture. Coal dust in a mine, and the fine floury dust in a mill give occasional instances of the tremendous energy latent in such mixtures.

2. Under control, fine sprays of liquid hydrocarbons or solutions of gaseous ones in ordinary air, furnish by explosion, the energy to drive gasoline or gas engines.

Exponent.—A small figure or figures placed to the right of and slightly above a numeral or mathematical symbol, denoting the power to which the magnitude is to be raised, as 7^3 , d^2 .

Export.—To carry away; to remove; to carry from state or country; to send out; as, valuable commodities to other nations or communities.

Expose.—To set forth; to lay out; to place in a position to be seen; as, to expose goods for sale.

Exposition.—An exhibition or show; as, of the products of art and manufacture.

Express.—1. To press or squeeze out; to force out by pressure.

2. Intended for a particular purpose; sent on a particular errand; dispatched with special speed or directness; as, an express messenger or train.

Expressage.—The charge for carrying a parcel by express.

Express Locomotive.—An engine specially constructed to draw trains at a high rate of speed.

Extended Piston Rod.—In locomotive engineering, a piston rod having a tail end, or reduced portion carried through a stuffing box in the top or front cylinder cover. Its purpose is to support the weight of the piston and keep it central.

Extended Smoke Box.—In railway engineering, a smoke box which extends out beyond the cylinder saddle and which has a large volume. It provides a space for the accumulation of sparks. Within certain limits, extending the length of the smoke box improves the draft.

Extended Wagon Top Boiler.—A locomotive, boiler in which a cylindrical course or strake of plating is interposed between the firebox and the taper course.

The object sought is to provide a seating for the steam dome without the radical staying necessary, should it be placed over the crown sheet.

Extensibility.—The capacity of being extended, or of suffering extension; as, the extensibility of a fiber, or of a plate of metal.

Extension.—That property of a body by which it occupies a portion of space; enlargement in breadth or continuation of length.

Extension Bit.—A bit having an adjustable cutter with which holes of different sizes can be bored.

Extension Bolt.—A type of bolt used to secure one leaf of double doors when seven feet high or over, replacing the common flush bolt. The extension bolt is worked from a thumb piece set in a short plate on the face or edge of the door.

Extension Lathe.—A type of lathe designed to do away with the gap and its consequent disadvantages. The upper part of the bed may be slid longitudinally along the lower part, its further end being supported by a standard or pedestal. The gap may thus be made of a length to suit the work, or the sliding bed may be pushed close up to the fast headstock.

Exterior.—The outward surface or part of a thing.

External.—That which is exterior; superficial; outward; visible from the outside.

External Fire Box.—In boiler construction, an outside fire box; that is, one not incorporated within the boiler proper and not surrounded by water; as, the cylindrical horizontal return tubular boiler with brick setting.

External Firing.—Heating a steam boiler by means entirely outside the boiler itself.

External Forces.—In mechanics, forces which act upon bodies from without, and are therefore the forces which produce strain.

External Screw.—In steam engineering, a screw cut upon the outside of a cylinder. Also called *male screw*.

Extinct.—Extinguished; put out; quenched; non-existent at the present time.

Extract.—1. To secure by expression, solution, distillation, or other means, the essential juices or constituents of any substance, subsequently concentrating the product.

2. A concentrated solution or distillate containing the characteristic constituents of any substance.

Extracting Worm.—A spiral or worm conveyor for removing crushed or powdered materials from storage bins. In cement manufacture, a spiral conveyor, provided with an appliance for accurate regulation of the quantity supplied, which draws powdered fuel from the bins, into which it has been delivered by the coal mill, and feeds it into the rotary kilns.

Extractor.—One who, or that which extracts; as, an instrument for extracting substances.

Extrados.—In architecture and civil engineering, the exterior curve of an arch; especially the upper curved face of the whole body of *voussoirs*.

Extremes.—In mathematics, the first and fourth terms of a proportion.

Eye.—1. A loop or ring formed in a cord, usually with a thimble to maintain its shape.

2. The hole in a hammer or axe head through which the handle passes.

3. The hole within a millstone for the passage of grain.

4. A bull's-eye protected by glass or mica through which the interior of a blast furnace or cupola may be examined.

5. An eyebolt.

6. The center or hub of a wheel designed to receive the shaft or axle.

7. The smaller opening in a crank arm or web, into which the crank pin fits.

8. The open space at the foot of a pit shaft, whence the different roads radiate, and where the stores, stables, etc., are situated. Also known as *pit eye*.

Eye Bar.—A very long and stout eye bolt used in the bracing of steel structures. More generally a flat link enlarged at either end and pierced for a bolt. A number of these links are built up three to five or so abreast on one pin, thus forming a chain; this being used instead of wire ropes for suspension bridges.

Eye Bolt.—A bar having an eye or loop forged at one end to accommodate a rope or block, and threaded at the other.

Eyelet.—1. A small aperture in a fabric or garment, worked around the edges like a buttonhole, or else lined with a metal ring.

2. The metal ring used to line an eyelet hole and protect the material from tearing. It is usually formed as a very short tube flanged at one end, which is forced into the opening, and the other end turned over and crimped to retain the eyelet in place.

Eyelet Set.—1. A hand machine, resembling a pair of pliers, used to insert eyelets in various materials.

2. A cup punch used by sailmakers, etc., to force and crimp over eyelets in sail cloth, etc.

Eyeletter.—1. A machine for inserting eyelets into boot uppers, etc. The modern machines are self feeding and semi automatic in action; also known as eyeleting machines.

2. A lever press used for forcing eyelets into a fabric.

E. & O. E.—An abbreviation standing for, in commercial transactions, the phrase, "Errors and omissions excepted."



F.—1. A letter, the sixth in the English alphabet.

2. An abbreviation for (1) Fahrenheit; (2) Fellow; (3) France; (4) Friday.

f.—An abbreviation for (1) farthing; (2) fathom; (3) foot; (4) folio.

F., Fah. or Fahr.—Abbreviations often used to signify according to Fahrenheit's scale, that of the thermometer most used in the United States and Great Britain.

Fabric.—The structure of anything; the manner in which the parts of a thing are united by art and labor; texture; tissue.

Face.—1. The principal surface of a solid; that flat surface of a piece of work which possesses the greatest area.

2. That portion of the curved outline of a tooth in a cog wheel, which lies beyond the pitch circle.

3. The surface upon which a slide valve moves.

4. The surface of a valve which comes into contact with its seat.

5. The dial of a clock or registering instrument of any description.

6. The dressed surface of a building stone; the front of a wall, or erection of any sort.

7. In mining, the place where the mineral is actually got; the working front of subterranean excavations.

Face Cutter.—A description of milling cutter in which the teeth are radially disposed upon the surface of a disc, either solid with it, or inserted in grooves.

Face Dust.—In a foundry, powder applied to the face of a mould which receives the metal to give the casting a smooth face, and make it easy to remove from its mould.

Face Gearing.—A form of toothed gearing; two discs turning at right angles to each other, furnished with cylindrical pegs upon their faces, meshing with one another and transmitting motion.

Face Lathe.—A lathe used exclusively for facing work, and distinguished from other lathes by its short beds, and deep gaps, sinking into a pit of the workshop.

Face Milling.—Operating upon work in a milling machine by means of a face cutter; the method is applicable to large surfaces, as the whole diameter of the cutter is operative.

Face Plate.—In a lathe, a disc or circular plate chuck upon which articles are bolted for boring or surfacing.

Facet.—A little face; applied in mechanics to the small parallelograms made at the points of chisels and drills; the sloping sides at the point of a cutting tool.

Facilitate.—To make easy or less difficult; to free from difficulty or impediment; to lessen the labor of.

Facility.—1. The quality of being easily performed; as, the facility of a work or operation.

2. Readiness proceeding from skill or use; dexterity.

Facing.—In founding, fine sand, etc., dusted over the surface of the prepared mould, to give a clean casting; face dust.

Facing Bellows.—A foundry tool used for blowing blackening into those portions of a mould inaccessible to the duster.

Facing Sand.—A mixture of coal dust, new sand and old or black sand, used by iron foundries to line the faces of moulds so that the molten iron shall not, by combining with the ordinary sand, form a rough, hard skin. The facing sand is rammed against the face of the pattern to a depth of about one inch, and the remainder of the mould filled with ordinary sand.

Facing Tool.—1. One used by iron moulders to face off their work.

2. Bricks made of cast iron, to rub off newly made concrete, and give it a smooth face.

Facsimile.—An exact copy of an original; as, of a coin, manuscript, or autograph, in all its essential features.

Factor.—One of two or more quantities which multiplied together form a product.

Factor of Horse Power.—The horse power developed in an engine of given piston area and rate of piston speed, multiplied by one pound mean effective pressure per square inch.

Factor of Safety.—A term expressive of a determined limit to which materials or machines shall be subjected; the safety limit; the ratio between the breaking load and the actual load.

Factor of Safety of the Steam Boiler.

—The number which expresses the ratio of the strength of the boiler to the working strain. The safe pressure depends upon the bursting stress or tensile strength of the plates, their thickness, the diameter of the boiler and the efficiency of the riveted joint.

Factory.—A manufactory; workshop; building or group of buildings, where operatives are engaged in the fabrication of merchandise, tools, and other utensils; as, a shoe factory, cotton factory, rubber factory.

Fagoting.—The process of refining iron from the puddled bar, by cutting the bar into lengths, forming them into a bundle or *fagot*, which is heated, hammered and welded into a solid mass and rolled to form another bar. By this means, further impurities are removed from the metal, and it is given its characteristic fibrous nature. The process is repeated, each time resulting in a better quality of iron.

Fahrenheit.—A thermometer scale in which the freezing point of water is 32° and the boiling point 212°; the most common instrument used in the United States, Great Britain and Holland.

Fair.—In mechanics, level, even; one part being in its correct relationship with another.

Fairlead.—A guide for ropes, generally with pulleys.

Fall.—1. To descend from a higher position to a lower, either suddenly or gradually; to drop down; to sink; to make a descent by the force of gravity.

2. That end of a block rope at which the force is applied.

Fall and Tackle.—A combination of pulleys arranged in one case to form a block (hence, "block and tackle") to secure a multiplication of power. The upper or fixed block gives the mechanical advantage of application, and the lower or movable block, by multiplying the travel of the rope as compared

with that of the weight, increases the power in proportionate ratio. Each movable pulley halving the power necessary, with two sheaves the force necessary is one-half of one-half, or one-quarter. Briefly, the weight capable of being lifted is equal to the force multiplied by twice the number of sheaves in the lower block, or by the number of "runs" of rope around them, which is the same thing; the friction of the tackle having to be deducted.

Faller Wire.—1. In spinning, a horizontal bar which depresses the yarns in a mule below the points of the inclined spindles on the carriage, so that they can be wound into cops. The *counter faller* (which sees) presses on the under side of the yarn and maintains the tension.

2. In silk spinning, a wire having an eye through which the thread passes to the bobbin; should the thread break, the wire drops and actuates a detent, stopping the bobbin.

Falling Weight Test.—In structural iron, a test to which rails and bars are subjected, the loads being produced by falling of weights.

False Bottom.—In millwrighting, the bottom of a mill formed of loose plates so as to permit the renewal of the bottom without disturbing its under structure.

False Face.—1. A hard cast iron, steel, or bronze face, fitted to a steam cylinder on which the slide valve works.

2. A clamp or jaw of lead, brass, or soft white metal made to fit on a vise to protect polished work from marking, also known as *vise clamp*.

False Frame.—In an automobile, a secondary frame built within the main frame of certain motor cars, to serve as a support for the engine, change speed gear and other accessories.

False Part.—In founding, a portion of the mould constructed to be drawn out for easy removal of an intricate pattern; also known as drawback, and (with brass foundries) as false core.

False Water.—In engineering, when steam is generated rapidly in a boiler, the immediate effect is a rapid rising of the water level in the gauge cocks, due to the increase in volume caused by *admixture of steam*. This sudden increase is termed false water.

False Work.—Timbering or scaffolding; a temporary structure used to protect and assist the construction of a permanent one; as, the false work of a bridge in course of erection.

Fan.—A rotary wheel like arrangement of vanes and hub combined with a suitable casing or conduit, moving volumes of air for purposes of ventilation, furnace draught, etc.

Fan Cooling.—A term applied to those automobiles in which the cylinders are air cooled, and the efficiency of the cooling is increased by a fan which circulates air through the radiator, etc.

Fang.—In mining, a channel or pipe for conveying air.

Fang Bolt.—In civil engineering, a bolt in which the nut is a triangular plate with teeth for biting into the timber, the bolt being tightened by revolving the head and shank. They are used for attaching iron work to timber.

Fangs.—In mining, cage shutters.

Fare.—The sum charged or paid for the conveyance of a passenger; as, on a railroad.

Fascine.—A bundle of small sticks of wood bound together in the middle. Used in military engineering for filling ditches and strengthening ramparts; in civil engineering, for making sea and river walls to prevent the washing away of the shore line.

Fast.—1. Possessing the quality and attributes of speed.

2. Permanent or secure, as a *fast* color or to make *fast* a ship.

Fast and Loose Pulleys.—The device installed for supplying belt power to machines. Two uniform pulleys are placed side by side upon the same countershaft, one keyed fast to it, the other revolving freely between stop collars. By sliding the belt side-wise from one pulley to the other, it either revolves idly or else drives the countershaft.

Fasten.—To make fast; to secure; as, by a lock or bolt; to attach or unite firmly; as, to fasten with cords or nails.

Fastening.—Anything used to secure or make fast; that by which one part is attached to another. Either permanently; as, a nail or rivet; or so that it may be released at will; as, a bolt or latch.

Fast Headstock.—The mandrel head of a lathe; so called because it is secured in an invariable position.

Fat.—1. A fat is akin to an oil in a solid state; both consist of glycerine with an organic acid; the large majority of fats possessing either, oleic, stearic, or palmitic acids. Oleine, a liquid formed from glycerine and oleic acid constitutes olive and almond oils and is present in castor oil. Stearine, a solid compound of stearic acid and glycerine, forms the bulk of beef and mutton suet. Palmitine, as its name implies, is the chief constituent of palm oil, and is formed by the addition of palmitic acid to the glycerine. Margarine, once thought to be a pure fat, is known to be a mixture of stearine and palmitine. Butter and milk are akin to fats. A soap is formed by the compound of a metallic base with either of these acids, and the consequent displacement of the glycerine. Ordinary yellow soap is *sodium oleate* or oleine and sodium, soft soap is *potassium oleate*, or potassium and oleine.

2. Anything of a greasy or unctuous nature; the fat of animals or anything resembling it.

3. Said of anything unctuous and plastic, as *fat clay* is one which is easily worked.

Fathom.—A measure of length, six feet.

Fatigued.—A term applied to material, as iron, when it has lost in some degree its power of resistance to fracture, due to the repeated application of forces, more particularly when the forces or strains have varied greatly in amount.

Fatigue of Metals.—The weakening which materials undergo by repeated straining beyond the elastic limit.

Fat Lime.—A lime prepared from a limestone which has few of the ordinary impurities of the rock, and therefore is a pure and active material, specially suitable for mortar.

Faucet.—1. A pipe to fit an orifice in a barrel or other vessel and provided with means for controlling the flow of the liquid;

2. A cock or tap for water or other liquids.

Fault.—In mining, a dislocation strata in the earth's crust, by which one portion of a bed is raised or lowered with relation to the other part. Where molten rock has filled the crack at the fault, it is called a dyke.

Fault in Castings.—The chief defects in castings are *blow holes*, *cold shuts*, *scabs*, or places where the metal has not filled the whole of the space in the mould, this being due to insufficient iron, too low a temperature at pouring, or portions of sand becoming detached from the mould and blocking the passage. Insufficient venting of the mould will produce the same effects.

Feat.—1. An act; an exploit.

2. A striking act of strength, skill, or cunning; a trick; as, a feat of dexterity.

Feather.—A key with parallel sides sunk into a recess on a shaft or spindle. The key way of the boss which fits upon the shaft is made a sliding fit upon the feather, so that, if necessary, the boss or hub, while always being driven by the shaft, may be moved lengthwise, as desired.

Feather Edge File.—A file, having two very sharp and two very obtuse angles; somewhat resembling two knife edge files, back to back.

Feathering Paddle Wheel.—In which the floats are controlled by an eccentric, fixed on the outer sponson or guard, so that they enter and leave the water in a nearly vertical position.

Feather Key.—A parallel key, fitted into a longitudinal groove in a shaft, permitting lengthwise movement of the piece which it secures. The same as *feather*, *reed* or *spline*.

Feb.—Abbreviation for February.

Feed.—1. To supply; to provide materials or requirements necessary for a process or operation; to supply for consumption.

2. Fodder and forage prepared for animals.

3. Material supplied for consumption in a process; as, the *feed* to a boiler.

4. The advance of material operated upon in a machine; as, of cloth to a sewing machine needle, or of the lathe in a milling machine; the supply of material to undergo a process; as, the feed of grain to a mill.

5. The advance of the cutlery tool, along its work; as, in relation to the work; as, in a lathe or planing machine.

Feed Check.—The non-return or check valve through which feed water enters a steam boiler.

Feed Cutter.—A variety of agricultural implements are grouped under this name, all used to prepare provender for cattle, etc.; comprising chaffcutters, root slicers and pulpers, and shredders for various roots and cereals.

Feeder.—1. An operator who supplies sheets of paper to a printing press.

2. A spring or stream that supplies a canal with water.

3. A branch or spur line of a railway which brings down traffic for the main line.

4. In foundry, a feeding head upon an irregular casting to ensure the supply of metal to extra thick portions in pouring.

Feed Escape Valve.—A safety or relief valve fitted to the delivery side of feed

pumps to prevent damage to the pump or pipes in case of a check valve being accidentally closed.

Feed Gate.—A door or trap in the casing surrounding the conveyer in a grain elevator, for regulating the passage of grain to or from the various bins.

Feed Gear.—The mechanism in a machine tool whereby a cutter is fed to its work or the work fed to the cutter; *self-acting mechanism*.

Feeding Head.—In foundry, an opening of proportionate size in the mould, through which hot fluid metal is poured or fed and worked by feeding rods so that the mould shall be kept full of metal as it shrinks in solidifying.

Feeding Rod.—In moulding, a bar of iron which the foundryman works up and down through the poured metal as it solidifies, to ensure the complete filling of the mould.

Feed Pipe.—The pipe through which the feed water is supplied.

Feed Pump.—The pump which delivers the feed water, usually heated, to the steam boiler.

Feed Regulator.—A device to maintain uniform water level in a steam boiler; usually by some description of float, which, through suitable gearing, controls the speed of an independent feed pump.

Feed Rod or Lead Screw.—A device on a lathe, used for moving the tool carriage in screw cutting operations, etc.

Feed Screw.—An auxiliary leading screw furnished to lathes to provide the linear advance of the tool, thus preserving the leading screw proper from undue wear, so that it remains in use for screw cutting only.

Feed Spindle or Shaft.—A longitudinal shafting, usually at the rear of a lathe, or sometimes in the middle of the bed, by which the saddle or carriage is moved in a desired direction.

Feed Suction Hose.—In a locomotive, a piece of rubber hose, conveying the feed supply from the bottom of the tender to the injector.

Feed Water.—The water supplied to a boiler to replace that evaporated; as, steam or blown off. *Net feed water* is the quantity of water necessary to supply a stated evaporation in a given interval of time; *gross feed water* is the net feed water plus the quantity necessary to provide for that blown out.

Feed Water Filter.—An apparatus in which the feed water has to pass through strainers covered with Turkish toweling or flannel to free it from grease. The filters are fitted in pairs or a by-pass is provided to permit cleansing of the filtering medium while in operation.

Feed Water Heater.—An apparatus for raising the temperature of boiler feed water, either by means of steam heated coils or by direct contact with a jet or spray of steam; exhaust steam being used in either manner. In addition to the fuel economy effected by hot feed, a preliminary heating frees hard water of much of its contained salts.

Feed Water Valve or Cock.—In a locomotive, an arrangement of a cock or valve with a rod or handle terminating in a lever or wheel above the tender foot plate, so that the water supply from the tender may be shut off.

Feeler.—A shop tool for gauging or "feeling," the accuracy of workmanship between two abutting surfaces. Thin strips of hardened steel of known thickness are employed, and by mounting several different sizes in a handle, like blades in a pocket knife, a great range of tests can be made by combining the blades.

Feldspar.—A mineral occurring in crystals and crystalline masses, somewhat vitreous in luster, and breaking rather easily in two directions, with smooth surfaces. The colors are usually white or flesh-red, occasionally bluish or greenish. It consists of silicate of alumina and potassium. Feldspar is one of the essential constituents of granite, gneiss, mica-slate, and porphyry, and enters into the constitution of nearly all volcanic rocks.

Fell.—The line which terminates a web in process of weaving, formed by the last weft thread; to sew or hem; said of seams only.

Felloe.—The exterior rim; or a part of the rim of a wheel supported by the spokes, also written felly.

Felsite.—A mineral composed principally of quartz and feldspar. The name is derived from a Greek word, *fels*, meaning a rock; also called *felstone*.

Felt.—A cloth or stuff made of wool, or wool and fur; fulled or wrought into a compact substance by rolling and pressure.

Felt Grain.—1. The grain or split timber which is transverse to the annular rings or plates.

2. The act of splitting timber by the felt grain.

Felting.—The interlacing together of woolen fibers into a compact substance; as, in hat making.

Felt Paper.—A coarse felt placed between two thicknesses of boards in building; either in floors to deafen sound, or in walls, to act as a non-conductor of heat.

Felt Wheel.—A polishing wheel used by electroplaters and metal finishers, made of woolen felt, the better and more durable quality being white. The wheel is used either with emery and glue, or with polishing compositions.

Felucca.—A boat or vessel, with oars and lateen sails, used in the Mediterranean. It has the peculiarity that the helm may be applied to the head or stern, as occasion requires.

Female.—Complementary parts of mechanisms often are designated male and female; as, internal screw threads are termed female threads, etc.

Fence.—1. A railing or skeleton wall, enclosing a space; made either of wood or of a variety of forms in iron.

2. An adjustable angle guide fitted to the bench of a circular saw, to gauge the width of the piece sawed.

3. A split piece of wood fitting on the blade of a carpenter's square, serving as a template to mark out a number of similar angles; as, in stair building.

Fencing.—Material ready-made for the erection of fences, either in standards or wire.

Fencing In.—In machinery, the enclosure of working machinery and revolving parts, in order to diminish the risk of accidents.

Fender.—1. Anything used to defend or to protect from injury.

2. A screen or guard placed before a fireplace to prevent accidents through sparks falling beyond the hearth.

3. A yielding ball or cushion of sennit lowered between a ship's side and that of another ship or wharf for the purpose of absorbing impact.

4. A wooden log, pile or walling used for similar purposes to the above.

5. A mudguard or splasher fitted over the wheels of vehicles to prevent them from throwing mud on the body.

6. A guard screen or protector fitted to the wheels of street railway vehicles or tram cars with a view to prevent accidents.

7. A guard placed at the angle of a building to protect it from damage by the wheels of passing vehicles.

Fender Pile.—A pile driven alongside structures on land or water, to protect them from the collision and impact of moving bodies.

Fenestra.—In building, a window like aperture.

Fenton's Metal.—An alloy consisting of 78% zinc, 17% tin, and 5% copper; used instead of lignum vitæ in muddy and sandy waters for stern bushes, etc.

Fermentation.—A class of decompositions which many organic bodies undergo in presence of a ferment.

Ferric.—A term signifying of or akin to iron; containing or extracted from iron.

Ferrite.—A name given to one of the states or developments of iron as revealed by the microscopic investigation of steel.

Ferro Chrome.—Either iron alloyed with chromium, or refined chrome iron ore employed as a hardening ingredient in the manufacture of steel.

Ferro Concrete.—Armored concrete; cement concrete reinforced by steel rods and bars suitably disposed to receive the tensile stresses, while the compression stresses are met by the concrete itself, which while weak in tension, possesses great strength to resist crushing.

Ferro Manganese.—In metals, a pig iron holding over twenty per cent. of manganese. Also called *ferro*.

Ferrule.—A cylindrical ring driven into the end of boiler fire tubes to fasten them tightly in the tube plates.

Ferry Boat.—A vessel, usually double ended, used to carry passengers, cattle, vehicles, etc., across a river, harbor or contracted water way. Barges of somewhat larger size are also used for the ferriage of both passenger and freight cars.

Ferry Push Car.—A very long flat car provided at some railway or transfer ferries, where the approaching gradient is too steep for the locomotive, so that other cars may be pushed on or pulled off without the engine going on the incline.

Ferry Slip.—The pontoon landing stage where the ferry boats arrive and depart.

Fettle.—1. To make ready or prepare for use or service; to furbish up.

2. To prepare the hearth of a puddling furnace with material which removes the carbon from the molten or viscous pig iron.

3. To dress castings after they are removed from the moulds; cleaning off the sand and removing runners and sprues.

Fettler.—A workman who dresses castings.

Fettling.—1. The process of cleaning or dressing castings.

2. The materials used as a bottom lining for a puddling furnace hearth: (1) "mill scale" or black oxide of iron as found around an anvil or formed upon bars and plates as they are rolled; (2) "bulldog," a mixture of ferrous silicate and ferric oxide, produced by roasting the *tap cinder* or slag of a previous puddling, together with the scale beaten out of the bloom as it is shingled under the hammer.

Fiber.—1. One of the delicate, thread like or string like portions of which the tissues of plants and animals are in part constituted; as, the fiber of flax or of muscle.

2. Any fine, slender thread, or thread like substance; as, a fiber of spun glass.

Fibrous Plaster.—A light strong material, consisting of plaster of paris with a stout canvas backing.

Fiddle Drill.—A bow drill, in which the tool is rotated by means of a cord strung in a bow; the cord is twisted around a reel or small pulley in which the drill is fixed, and the passing of the bow backwards and forwards revolves the drill alternately in either direction.

Fiddly.—The iron casing and gratings around the funnel of a steamship.

Fidelity Bond.—A guarantee or surety given for the due performance of engagements by one of the signatories; a provision for indemnity against defalcations.

Field.—Out door operations as apart from factory or office working; a civil engineer when on construction work, or, more properly, location and survey, is said to be

employed in *field work*; in the petroleum business, the production of oil as differentiated from its refining and marketing.

Field Book.—A book used by civil engineers, surveyors, etc., in which are set down in an orderly method and proper sequence, the distances measured, altitudes taken, together with the various notes to be recorded.

Field Tube.—An arrangement of two concentric tubes, which greatly improves the circulation and steaming capacity of a vertical boiler; the heated water rises in the annulus between the inner tube and the exterior heating surface, while the cold water circulates down the inner tube.

Fife Rail.—A balustrade over the break of the poop or around a mast.

Fifth Root.—In mathematics, a quantity resolved into five equal factors, each factor is the fifth root. Example: Two would be the fifth root of thirty-two, for two multiplied by itself five times equals thirty-two.

Fifth Wheel.—A horizontal wheel like bearing or pivot supporting the front axle of a vehicle, enabling it to be revolved at an angle for turning corners; by the arrangement of a worm gearing, the fifth wheel can be made to serve as steering gear.

Fig.—Abbreviation for figure.

Figure.—A character standing for, or representing a number; a numeral; a digit; as, 1, 2, 3, etc. Clearly made figures, neatly placed in their appropriate position for adding, subtracting, and dividing, etc., are most agreeable to the eye, and useful to both maker and reader.

Figure Weaving.—In weaving, the process of combining different threads in such a manner as to make a pattern or figure in the fabric.

File.—A steel instrument, having its surface covered with sharp edged furrows or teeth, used for abrading or smoothing other substances; as, metals, wood, etc.

File Card.—A piece of card cloth, used for cleaning files from metallic dust.

File Cutter.—The workman who cuts the teeth on a file.

File Cutting.—The art or process of making files; the blank of annealed steel is placed on a leaden bed, and the serrated teeth cut by means of a straight edged chisel, the workman gauging the spacing by his finger nail. Rasps are made in the same manner, but their teeth are burrs made by a sharp pointed punch instead of ridges formed by a chisel.

File Holder.—1. A contrivance attached to a machine that files.

2. A receptacle for keeping files and documents.

Filigree.—One of the most ancient kinds of jewelers' work consisting of fine gold, silver, and even copper, wire formed into a delicate tracery or scroll work.

Filing.—1. The act of filing; as, in cutting down in metals, wood and stone.

2. The arranging in proper order of letters, papers and other documents for ready reference.

Filings.—The particles of metal, such as iron or brass, produced by the action of a file or rasp.

Fill.—In railroad construction, an embankment where the depression below the surface line is filled in by the spoil or waste taken from above the surface line, hence, "cut and fill."

Filler.—A liquid or paste used by painters to fill up the grain of wood and make a smooth surface before polishing, painting or varnishing.

Fillet.—A narrow moulding or rim; generally the concave curve or moulding at the change of section of a portion of machinery; as, in a journal; in pattern making, lengths of leather or flexible metal, shaped to a given concave radius, from which the pattern makers cut pieces to form the fillets on a pattern.

Filling.—Anything that stops up a hole or vacant space. In civil engineering, the embankment made on low ground to bring the road up to the surrounding level.

Filling Engine.—In silk manufacture, a kind of carding machine, in which the fibers of floss silk and waste are disentangled and laid parallel.

Fillister.—In carpentry, a kind of moulding plane used for grooving or forming rabbets; as, in window sashes, or for filleting mouldings. Anything slotted; as, with a fillet; as, a fillister moulding screw head. A round headed screw is generally known as a fillister head screw.

Filter.—A strainer; a vessel in which water or other fluid is passed through a porous medium to free it from substances mechanically mixed with it.

Filter Bed.—A layer of sand and gravel through which water intended for household use is allowed to slowly filter before passing into the reservoir and distributing system.

Filter Hood.—The upper or receiving part of a filter. It is generally funnel shaped so as to make it easy to pour the liquid into the filter.

Filtering.—Various mediums are used in the process of filtration; charcoal and bone black when it is desired to retain or remove certain gases, etc., sand or gravel for rough filtration in large quantities, and silica or sponge for fine work. A sponge filter is easily reversible, which means that a current of water forced through it in the reverse direction rapidly cleanses the sponge medium.

Filth.—Foul matter; anything that soils or defiles; dirt.

Fin.—A projection or ridge on a casting at the point where the parts of the mould should have joined.

Final Pressure.—In steam engineering, that pressure which would exist in the cylinder of an engine if the expansion were continued to the end of the stroke instead of being interrupted by *pre-release*. It is usually called *terminal pressure*.

Fine.—1. Superior; delicate; having a high degree of excellence.

2. Containing a certain proportion of pure metal, as coin nine-tenths fine.

Fine Drawing.—In cloth manufacture, a finishing process in which the cloth is exposed to a strong light, and any minute hole or break is repaired by introducing with a needle sound yarns in place of defective ones.

Fine Drawn.—Drawn out to extreme fineness; as, wire.

Fine Hard.—In tool making, an emery wheel, used for very particular work on account of its fine finishing quality.

Fine Metal.—In smelting, *matte* which is obtained from the fusion of calcined coarse metal, such as copper or slags and ores.

Fine Soft.—In instrument making, a class of emery wheels noted for its fineness and used for polishing.

Fine Teeth.—In tool making, the teeth of tools are called *fine* when of small dimension, as relative to others.

Finger.—Something like or likened to a finger; a measure of length, commonly that of the middle finger; in agricultural machinery, one of the sharp pointed knives, made either of cast steel or malleable cast iron, fixed upon the cutter bar of a reaping machine.

Finger Bar.—In agricultural machinery, the fixed portion of the cutting bar of a reaping machine; it is provided with compensating gear to permit it to accommodate itself to the inequalities of the ground.

Finger Grate.—A type of firebar used in connection with rocking grates, having the shape of a spine with ribs projecting alternately from either side. These projections are known as fingers, and those of one bar interlace with those on the next, disengaging as the bars are rocked and permitting ash and clinker to fall through.

Finger Guard.—The bow shaped part of a sword hilt which protects the fingers; called also a knuckle bow. In mechanics, generally, any device which serves to protect the fingers of operators from injury by machinery.

Finger Plate.—In carpentry, a strip of metal, glass, etc., to protect a painted or polished door from finger marks.

Finger Post.—A guide post bearing an index finger, used on road crossings to show the different destinations of the crossing roads.

Finial.—In building, an ornament on the top of a spire, pinnacle or the like.

Fining.—To make clear or pure, as to fine gold; to fine wine, in which alum, isinglass or white of eggs is used to precipitate the sediment.

Finish.—The last work performed upon any object whereby it is completed or perfected; this word has come to mean not merely to complete in the essentials, but to perfect in all the minute details.

Finished Surfaces.—Those portions of a piece of machinery which are machined or filed to a smooth polished surface, either for jointing where one part abuts on another, or for the sake of appearance. A *machined* surface is one where smoothness or high polish is not demanded, the work being left with minute ridges and tool marks, which would be removed in finishing.

Finishing.—In textile manufacture, the art of preparing fabrics with a glossy smooth surface, firmness of texture and an attractive appearance after manufacture, so as to be fit to put upon the market.

Finishing Cuts.—In machine shop practice, the *last cutting* with a scraper or spring tool on the surfaces of castings and forgings.

Finishing Drill.—A drill or, more properly, reamer, used to make a smooth finished hole to gauge size, following a boring tool or coarsely fed drill.

Finishing Stove.—A stove used in book-binding, generally a gas stove with a circular top and outside ring. The tools rest upon the ring while the metal ends are being heated on the plate.

Fin Keel.—A term used as the opposite of a centerboard or shifting keel.

Fink Valve Gear.—A type of reversing or expansion gear, in which the link is part of the eccentric strap.

Fir.—A tree of the pine family. The hemlock, spruce or fir, is the American hemlock of the lumbermen.

Fire.—The evolution of light and heat in the combustion of bodies, or that active natural process by which burning bodies are decomposed with the evolution of heat and light; combustion; state of ignition.

Fire Alarm.—An apparatus for giving or communicating an alarm of fire; as, by telegraphic signals.

Firearm.—A weapon which projects a missile by the explosion of gun powder. Many different mechanical devices have been invented and patents on improvement taken out.

Fire Bars.—The bars on which the fire rests in the furnace of a steam boiler.

Fire Basket.—A frame work of iron bars in which coals or wood are burnt to make a signal fire.

Fire Box.—The chamber in which the fire in a locomotive is placed.

Fire Box Arch.—The upper part of the fire box, and that part where the flues are attached and which at the same time forms the bottom of the water holder.

Fire Box Back Sheet.—The rear end plate of the internal fire box of a locomotive.

Fire Box Iron.—(C. H. No. 1 F. B.) An iron of hard quality, designed especially to withstand the destructive effect of the impinging flame, and used for boxes and flue sheets.

Fire Box Stays.—In a locomotive, the screwed bolts holding the internal and outer fire boxes together.

Fire Box Tube Sheet or Plate.—The plate forming the front wall of the internal fire box, farthest from the door, which is perforated to receive the tubes.

Fire Brick.—A refractory brick, capable of sustaining intense heat without fusion, composed largely of fire clay.

Fire Brick Arch.—The characteristic feature of a locomotive fire box. In the early days, locomotives burnt coke alone, and in endeavoring to adapt them for coal burning, many strange devices were employed. The simple plan was as usual the best, the construction of the boiler being unaltered save placing an arch of fire brick within the fire box, which not only deflected the flame currents, but protected the tube plate from cold air, while the mass of incandescent brick work ignited any unconsumed gases which left the fire. With the addition of the arch and the deflectors over the door, the fire box of a locomotive is converted into a gas furnace, distilling the gases from the fuel on the bars and burning them as a mass of solid flame in contact with the arch.

Fire Bucket.—A bucket to convey water to extinguish fire.

Fire Clay.—A kind of clay, chiefly pure silicate of alumina, capable of sustaining intense heat, and hence used in making fire bricks.

Fire Damp.—A gaseous compound, chiefly marsh gas (light carbureted

hydrogen), exhaled from the coal in many mines; it is explosive when mixed with atmospheric air. To prevent its ignition safety lamps are used.

Fire Door.—The opening in a boiler front through which the coal or other fuel is put into the furnace.

Fire Door Hood.—A curved piece, fixed on the boiler head over the door opening, projecting some inches so as to protect the eyes of the fireman from the glare of the furnace; it also serves as a stand for oil feeders, etc.

Fire Door Ring.—A distance ring, interposed between the two fire boxes at the doorway, all three being riveted up with through rivets.

Fire Door Shield.—A shield arranged so that if the fire door of a boiler is opened to permit the fireman to put on coal, his face is protected from the glare of the fire. To some extent used in railroad work in the tropical countries where wood is used as fuel.

Fire Drill.—An apparatus designed to be worked by hand to kindle a fire in tinder by means of a bow fire drill.

Fire Engine.—A machine for forcing water through a hose to extinguish fires. It was formerly worked by hand power but is now generally operated by steam, even being self-propelled. It consists essentially of powerful suction and force pumps mounted on wheels. A chemical fire engine is a fire extinguisher of large size on running gear.

Fire Escape.—A contrivance for aiding persons to escape from the upper stories of a burning building; it may be permanent in form like the light iron balconies, which are usually attached to the outside of apartment houses and connected together by iron ladders, or it may be a system of ropes or straps by which one may be lowered. The same purpose may also be accomplished by a series of ladders which are raised from a wheel carriage on the ground, and jointed together forming a single ladder of considerable length, by which one can descend by the rungs or through a canvas trough or tube.

Fire Extinguisher.—An apparatus for putting out a fire in its early stages. A common form contains a small vessel filled with a mineral acid, which, by coming into contact with a solution of bicarbonate, generates carbon dioxide. This gas mixed with the water of the solution, is then thrown on the fire through a hose by its own pressure.

Fire Float.—A self propelled vessel, equipped with powerful pumps, for use as a floating fire engine in docks and harbors.

Fire Guard.—A framework of iron wire, to be placed in front of a fire place; a fender.

Fire Hook.—A large hook for pulling down buildings in conflagration.

Fire Hydrant.—A hydrant for use in extinguishing fires, having connections for a hose.

Fire Lighter.—A composition; as, pitch and sawdust for lighting fires.

Fireman.—A stoker; the attendant on a boiler furnace, supplying it with fuel and manipulating the fire; on a locomotive, the fireman not only has to replenish the fires and keep the cab clean, but tends the water and also the hand brake if necessary.

Fire Pails.—Pails which are kept full of water and are used for fire only; regulations have been made by different authorities relating to their use.

Fire Policy.—A fire insurance policy.

Fire Pot.—The lower part of a stove or furnace in which the fire is made; a portable furnace heated by coke or liquid fuel, used by plumbers, etc., for melting lead, heating irons, etc.

Fireproof.—Incombustible; proof against fire.

Fireproofing.—The process of treating textile fabrics with some chemical solution which will make them less liable to burn, also the various methods of building construction which have in view the same result.

Fire Pump.—A steam pump, fitted for fire service, with high pressure connections to hydrants, etc.

Fire Setting.—A method of excavating rock, by heating it with a fire against its face, then cooling it rapidly with water, which cracks it so much as to be easily broken down with picks, gads, etc.

Fire Surface.—The heating surface of a boiler, subject to the action of flame and hot gases.

Fire Test.—A method of testing the flash point of oils, by heating a small quantity in a cup, within which is a thermometer to gauge the temperature; at stated intervals a lighted taper is passed over

the surface of the oil, and the point at which the vapor ignites is noted as the flash point.

Fire Tube.—A tube in a boiler which serves as a passage for flame and heated gases.

Fire Tube Boilers.—In these, the small tubes are filled with the products of combustion, as in the common tubular boiler. The distinguishing difference which marks the fire tube from the water tube consists in the fact, that in the former, the small tubes are filled with the products of combustion, instead of water. The difference has been expressed in another way—"Water-tube vs. shell boilers." The principle of steam production in both systems is the same; the heat from the combustible is transferred to the water through the medium of iron plates, and in both, the furnaces, steam appliances, application of the draught, etc., are substantially the same. In another important point do the systems agree, *i. e.*, in the average number of pounds of water evaporated per lb. of combustible; it is thoroughness of construction and skillfulness of adaption to surroundings that produce the best results.

Fire Works.—Preparations of gunpowder, sulphur, and other inflammable materials, used for making explosions in the air, on occasions of public rejoicing; pyrotechnical exhibitions; also, various combustible preparations used in war.

Firing.—The application of fire to fuel, such as firewood or coal; the act of replenishing a fire with combustible.

Firing Marine Boilers.—The production and maintenance of steam in the boilers of a vessel propelled by steam. The temperature of the boiler room is ordinarily 120°, but sometimes reaches 160°, and the work is then terribly hard.

Firing Newly Set Boilers.—Boilers newly set should be heated up very slowly, and the fires should not be lighted under the boilers for at least two weeks after setting, if it is possible to wait this length of time. This two weeks enables all parts of the masonry work to set gradually and harden naturally; the walls will be much more likely to remain perfect, than when fires are lighted while the mortar is yet green.

When fire is started under a new boiler the first time, it should be a very small one, and no attempt should be made to do more than moderately warm all parts of the brick work. A slow fire should be kept up for twenty-four hours, and on the second day it may be slightly increased. Three full days should elapse before the boiler is allowed to make any steam at all.

When the pressure rises, it should not be allowed to go above four or five pounds and the safety valve weight should be taken off to prevent any possibility of an increase. Steam should be allowed to go through all the pipes

attached for steam, and blow through the engine before any attempt is made to get pressure on them.

Firing of Steam Boilers.—This comprises three things: (1) The preparation, which includes the partial filling with water and the kindling of the fire. (2) The running, embracing the feeding, firing, and extinction or banking of the fire. (3) The cleaning out after it has been worked for some time. Before lighting the fire under a boiler the engineer or fireman should make a rapid yet diligent examination of various things, *viz*: (1) He should make sure that the boiler has the right quantity of water in it—that it has not run out during the night or been tampered with by some outside party; very many boilers have been ruined by neglecting this first simple precaution. (2) He should see that the safety valve is in working order; this is done by lifting by rod or hand the valve which holds the weight upon the safety valve rod. (3) He should open the upper gauge cock to let out the air from the boiler while the steam is forming. (4) He should examine the condition of the grate bars and see that no clinkers are left from the previous firing.

Firing with Tan Bark.—Tan bark can be burned upon common grates and in the ordinary furnace by a mixture of bituminous screenings. One shovelful of screenings to four or five of bark will produce a more economical result than the tan bark separate, as the coal gives body to the fire and forms a hot clinker bed upon which the bark may rest without falling through the spaces in the grate bars, and with the coal, more air can be introduced to the furnace.

The above relates to common furnaces, but special fire boxes have been recently put into operation, fed by power appliances, which work admirably. The "point" principally to be noted as to the efficacy of tan bark as a fuel, is to the effect, that like peat, the drier it is the more valuable is it as a fuel.

Firkin.—A measure of capacity, being the fourth part of a barrel, and equal to nine U. S. gallons, or seven and a half Imperial gallons.

Firm.—Compact; hard; solid; applied to the matter of bodies; as, firm wood, firm cloth, etc.

Firmer Chisel.—A tool used in carpentry to chisel with the hand, no force being needed as is necessary with a grooving chisel or mortising chisel.

First Motion Hoisting System.—A type of hoisting arrangement where the rope drum is mounted directly upon the crank shaft of the engine; as, in an ash hoist on shipboard or the winding engine of a colliery.

Fish.—1. In civil engineering, a strengthening or stiffening bar laid alongside another; as, the fish bar which splices

the end of adjacent railroad rails, and decreases the tremor or depression at the joint, or the bar which breaks the joint of scarfed timber.

2. In navigation, a purchase for hauling in, on the gunwale; the *fluke* of an anchor.

Fish Bellied.—1. Bulging out from the proper line; shaped like the belly of a fish; as, a fish bellied beam, a fish bellied rail.

2. In engineering, girders, etc., so curved that the lower surface bows downward.

Fish Belly File.—A steel instrument for abrading or smoothing surfaces, having raised cutting edges made by the indentations of a chisel; and formed with a convex surface on the under side.

Fish Bolt.—The snap headed oval shanked bolts used to connect rail joints.

Fishery.—A fishing establishment, comprising the buildings and equipments generally required in any particular fishing business.

Fish Glue.—A glue prepared from the *sounds* or swimming bladders of fishes; isinglass, from the sturgeon, represents a high quality.

Fishing.—In mining, operations for the recovery of parted tools, severed casing, or things fallen in a bore hole. A reinforced joint made by clamping the two ends together between pieces which overlap or cover the joint.

Fishing Tools.—Applying to a great variety of tools or ingenious appliances used by well drillers and mechanics to recover broken and dropped drills or other matter from within a drilling; as, in preparing a drilling for blasting.

Fish Joint.—A splice consisting of one or more pieces of iron or wood bolted to the side or sides of two adjacent rails, where the head of one meets the foot of the other.

Fish Pen.—A curved steel point fixed in a stout handle, used in handling pickled and dried fish, especially cod. Also called *fish prong*.

Fish Plate.—A splice bar for rails. Also called fish joint.

Fish Tackle.—A tackle used for raising the flukes of an anchor to the gunwale of a vessel.

Fish Tail.—1. In marine engineering, a single bladed propeller, operated with an oscillating movement not unlike that of a fish swimming.

2. A gas burner in which the flame spreads out in shape like a fish's caudal fin.

Fish Tail Burner.—Pertaining to a gas jet, so designed as to form a flame resembling the tail of a fish.

Fish Van.—An English refrigerator vehicle used for the conveyance of fresh fish.

Fissure.—A cleft, crack, or division; specifically, a cleft in the earth as caused by an earthquake.

Fissure Vein.—Ore occupying a fissure caused by a movement of the earth's crust, as distinguished from a crack in the rock itself.

Fit.—This is an important word used in shop practice, meaning to adjust, to equip, to bring to a required form or size.

Fitch, John.—Born 1743, died 1798. An American inventor, one of the first to apply steam to boat propulsion. He built his first model of a steamboat (1785), and the following year succeeded in constructing a steam engine which worked well in propelling a boat; this was further developed until, in 1787, a steamboat was built by him which went at the rate of 3 or 4 miles an hour, a speed surpassed by his later boats; in 1796 he built a small screw steamer, but encountering opposition and pursued by ill fortune, he was unable to provide the funds necessary to perfect his plans.

Fit Strip.—A projection, usually about an inch wide, that is intended to be fitted to bed the piece properly and save bedding the entire surface of the piece.

Fitter.—One who fits or adjusts different parts together; as, a fitter of machinery, steam fitter, gas fitter, etc.

Fitting.—Anything employed in fitting up permanently; used generally in the plural, in the sense of fixtures, tackle, apparatus, equipment; as, gas fittings.

Fixed Pulley.—One in which the rope passes over a sheave in a fixed block.

Fixtures.—An important term used in connection with drilling machines, jigs, agricultural implements, etc., meaning things annexed to machinery; any appendages or parts of the furniture of a house which are attached to it by rails, or screws; as, gas fixtures, etc.

Flag.—A piece of silk or bunting, on which is a device; used as a standard or signal.

Flagging.—Flat paving stones arranged as a flooring; a covering of tiles.

Flagging Iron.—A tool with a double hooked head used by coopers to pry open the seams of casks when caulking them; so called because the seams were formerly stuffed with leaves of the cat's tail flag.

Flagstone.—Any rock or stone, which may be readily split into flat slabs suitable for paving walks or courtyards.

Flake White.—Pure white lead in flakes used as a pigment.

Flame.—The burning of gas or vapor which is given off from the combustion of a solid or liquid substance. By luminous flame is generally meant that which burns with a bright yellow to white color. All flame under a steam boiler is not luminous, sometimes the whole or a part of it will be red or blue.

Flang.—In mining, a double pointed pick.

Flange.—1. A projection.

2. An external or internal rib or rim for strength.

3. A plate or ring to form a rim at the end of a pipe when fastened to a pipe. A blind flange is a plate for covering or closing the end of a pipe.

Flange Coupling.—A general method of connecting one length of shafting with another, by means of a disc or circular plate formed upon the end of each piece or secured thereto by keys; the strain being transmitted from one disc to another by driven coupling bolts.

Flanged Pulley.—A belt pulley provided with flanges upon its circumference to retain the belt in place. This is used instead of crowning, and is necessary where a flat belt is required; as, in conveyers or well boring rigs. Three flanges are sometimes provided where two narrow belts must be driven off one pulley.

Flanged Union.—The usual method of connecting one length of pipe to another, by means of flanges, screwed or brazed on the end of either pipe, with jointing material between them, the whole being brought together by through bolts.

Flanged Wheel.—A name sometimes given to a shrouded spur wheel or pinion.

Flange Iron.—A term applied to soft ductile wrought iron which can be easily worked, and can stand the heavy stresses due to flanging, used around steam domes of boilers, etc.

Flanging Press.—A machine for bending the edges of boiler plates, etc.; to form a curve or bent edge or flange.

Flank.—The side or lateral part of anything; that portion of the curved outline of a cog in a toothed wheel which lies within the pitch circle.

Flannel.—A soft nappy woolen cloth of loose texture. Some flannels have both sides alike; others have a long nap on one side and none on the other.

Flap.—Anything broad and flexible that hangs loose, or that is attached by one end or side and easily moved; as, a heavy valve.

Flap Door.—A form of door with hinges on the lower side, so that it opens downward and outward. Also called *falling door*.

Flap Tile.—In building, a curved tile for forming a corner or receiving a drip.

Flare.—1. A spreading outward; to incline outward from a perpendicular.

2. A signal of distress at sea, made by burning turpentine, etc., on a hand apparatus.

Flare Back.—In navigation, a term used to describe the retarded inflammation of the gases arising from a previous discharge of a gun on a warship. This is akin to the *back draft* of a steam boiler.

Flash.—To burst into sudden flame; to burst suddenly into action; break out with sudden force or violence.

Flash Boiler.—A boiler consisting of a series of coils of steel tubing, water is supplied by a pump on the engine which delivers the water to the top coil, from whence it circulates through the other coils, becoming heated in its descent and issuing from the lower coil, as *highly superheated steam*.

Flash Generator.—A term used sometimes for flash boiler.

Flashing.—The operation of expanding crown glass into sheets for window glazing, etc. The blown bulb or *form*, is attached to a *punty* or *working rod* at its apex, the blowing iron being cut off by a chisel dipped in water. The workman stands before the flashing furnace, with his face veiled, exposing the opening of the bulb to the intense flame, while he twirls the punty, which is supported horizontally by a crotch or fork. The lips of the opening soften and the glass finally expands into a large circular disc or *table* which is kept from folding on itself by constant twirling.

Flashing Board.—A device for increasing the depth or force of a stream of water by diminishing its width; as, a board set up on edge on the top of a mill dam when the stream is low.

Flashing Furnace.—The furnace at which a previously blown spheroid of crown glass is expanded into a flat circular table.

Flashings.—In building, pieces of sheet tin, lead, copper or zinc, employed in roofing to make watertight the corners and edges in hips, valleys, ridges, or around chimneys.

Flash Light.—A type of lighthouse or signal light in which the rays are rendered intermittent by being alternately obscured and revealed. A bright light obtained by the burning of magnesium powder or ribbon, used for obtaining photographs of interiors.

Flash Point of Oil.—The temperature at which oil gives off explosive vapors. It is determined by heating the oil with a thermometer immersed in it, and applying a flame as the temperature rises. Sometimes, the oil is heated in shallow cups of a specified size, and a taper is passed over the surface to cause ignition; this is termed the "open flash" test. A more usual and accurate method is that known as the "Abel test," where the oil is placed in a standard closed vessel immersed in a heated bath, both vessels being provided with thermometers.

Flask.—A foundry box, the frame of iron or wood into which sand is rammed upon a contained pattern to form the desired mould.

Flask Clamps.—In founding, clamps made of wrought or cast iron, used: (1) to hold the mould board on the flask in "roll-over" work; (2) to hold the various boxes together and resist the lifting pressure of the metal as it fills the mould. Such clamps are usually applied by means of wedges.

Flask Pin.—In moulding, a pin to fasten the cope and nowel together and maintain them in their proper relative positions.

Flat.—Lying all in one plane; without rotundity, curvature or other variation or inequality. In textile manufacture, a flat panel containing card clothing above the cylinder of a carding engine.

Flat Arch.—One in which the lintel or lower portion of the arch is flat; used more frequently in brick than stone work, and usually where it does not support much weight.

Flat Bar Iron.—Such iron as is rolled into long, rectangular strips, suitable for blacksmithing and other work.

Flat Boat.—A flat bottomed boat of considerable size, roughly made of strong timbers for floating merchandise, machinery, etc., down the Mississippi and other Western rivers. At the end of the downward voyage, they are broken up and their materials sold.

Flat Car.—A railway freight vehicle, consisting solely of a platform mounted on two four wheeled bogies or trucks.

Flat File.—A common, double cut file of various grades of fineness of cut; sometimes tapering and sometimes of uniform size through the whole length.

Flat Head Screw.—A screw with a countersunk head.

Flat Key.—A shop term for a splitter cotter.

Flat Pattern.—A copy made of stout paper or sheet metal from which an object is to be reproduced. A guide for forming the outlines of a metal sheet which has afterwards to be bent into a curved vessel.

Flats.—In mining, ore veins, principally of lead, which are branched out or deposited in flat masses. In a locomotive or car, that portion of the circumference of the tire of a wheel where the curvature has been worn away by skidding, etc.

Flattening.—1. The act or process of making flat, smooth or level.

2. In painting, covering surfaces with broad stretches of color without gloss, varnish or massing.

3. In currying, the method of removing minute shavings from the stretched surface of a hide.

Flatter.—A smith's tool with a broad face, held by a handle on the work, and struck upon its head with the sledge. Used to dress and smooth work after being drawn to shape by means of fullers or set hammers.

Flattening Stone.—In glass making, the bed or stone on which the cylinders of sheet glass are flattened for glazing purposes. The flattening stone is a hard level mass of fireclay and cement, usually of fine quartz.

Flaw.—1. A defect or imperfection; a crack in otherwise solid metal.

2. A sudden gust of wind.

Flax.—The skin or fibrous part of the flax plant, when broken and cleaned by hatching or combing; linseed oil is expressed from the seed.

Fleam.—In saw filing, the keen edge given to saw teeth by filing their front faces at an acute angle to the plane of the saw blade.

Flemish Bend.—A bend or knot, employed by seamen, whereby an eye or thimble is secured to the end of a rope.

Flemish Bond.—The second strongest method of laying bricks, headers and stretchers alternating in the same course, the joints in alternate courses breaking bond with each other.

Fleshing Knife.—A tool with two handles used for removing the hair, fat and loose flesh from hides.

Fleshing Machine.—In tanning, a machine used in the stripping of flesh from the hide.

Flexible.—Easily bent without breaking; pliant; not stiff.

Flexible Joint.—A connection arranged between two pipes to permit of their independent motion.

Flexible Shafting.—A pliant shaft, much used for driving drills and which may be connected directly to an electric motor; a shaft composed of a number of concentric spiral coils of wire, wound alternately right hand and left hand

over each other, thus giving flexibility when revolving like an ordinary shaft.

Flexible Spout.—A conduit used in connection with grain elevators, usually for trimming railway cars or vessels without shoveling.

Flexible Stay Bolt.—The internal firebox of a locomotive is stressed in a variety of ways, and, if held too rigidly by its staying, cannot accommodate itself to meet the strains, therefore either the plates or stay bolts carry away, generally the latter. To permit a certain amount of flexibility, a type of stay bolt has been devised, in which the outer end is not screwed into the wrapper plate, but terminates in a ball or hemisphere. This rests upon a cupped surface within a socket or cap, which latter, being screwed into the outer firebox, transmits the tensile stress. The stay bolt is, in a manner, pivoted upon its cup shaped seating, and so is capable of self adjustment to meet the strains, and the motions set up by expansion and contraction.

Flexible Wheel Base.—That portion of the wheel base of a locomotive in which provision is made for circular movement, by means of trucks or bogies, or radial axle boxes.

Fluxure.—1. A bending; a part bent; a fold.

2. The change of shape of an instrument by its own weight.

3. In geology, a bending or folding of strata under lateral or side pressure.

Flier or Flyer.—1. Some part of a mechanism having a rapid rotary movement, as the fanwheel which regulates the motion of a windmill head.

2. The pivoted rack or frame in a printing press, which swings backwards and forwards to take the printed sheets off the press and lay them in a pile.

3. A single straight step in a flight of stairs.

Flint.—An intensely hard mineral, commonly of a steel gray color. It possesses the property of emitting sparks when struck with iron and steel. It is the purest of the silica group of minerals.

Flint Glass.—A kind of glass formerly made of flints, hence its name. It is not as hard as crown, plate or window glass and is accordingly used for cutting or engraving. Most tableware, ornamental glass and optical instruments are made of flint glass.

Flint Grinder.—A sort of wash mill in which flints, after calcining and preliminary crushing, by means of stamps, are ground into powder for mixing with china clay to form porcelain.

Flitch Beam.—In carpentry, a compound beam made of planks fastened side by side. Also called *built beam*.

Flitch Plate.—A flat iron plate used to reinforce compound beams, made partly of wood and partly of iron. Also a strengthening plate used on the heavy timber connections on mining pumping machinery.

Flitch Plate Girder.—A girder made of plates which are fastened side by side, by riveting angle irons on each side of top and bottom of the girder.

Float.—1. An object which floats on a liquid; as, a raft.

2. A plasterer's spreading trowel.

3. A dock or basin in which a ship is floated.

4. A vane on the wheel of a paddle steamer, or a similar vane in a wheel which actuates any fluid or liquid or is actuated by it.

Float Chamber.—That portion or compartment of a float feed carburetor in which the float is situated, and which contains a supply of the liquid fuel for immediate use.

Float Coat.—A thin wash of plaster of paris on a mortar coating.

Float Feed Carburetor.—A carburetor for internal combustion motors, in which a cork or hollow metal float controls the height of the gasoline or other liquid fuel in the atomizing nozzle.

Float File.—A smooth file made in various forms, having a *single* cut as distinguished from double cut files which have two crossing rows of teeth.

Floating.—In weaving, a weft thread which floats or spans across several warp threads.

Floating Dock.—A pontoon or structure composed of floating pontoons, which form a platform with side walls. Portions of the dock are filled with water which submerges the platform to suitable depth for the reception of a ship; as soon as the vessel has been manoeuvred into position, the pumps with which the dock is provided eject the water, and the whole fabric rises, bearing the ship out of water. This type of drydock is employed in many places for underwater repairs or inspection of shipping. The modern floating dock is *self-docking*; that is, the pontoons may all be detached one by one, taken aboard the platform for scaling, painting or necessary repairs.

Float Ore.—1. Pieces of ore carried from their native bed by the action of water.

2. Small particles of metal too light to settle through the water in a concentrator.

Float Trap.—In steam engineering, a trap in which the rise of the level of the water of condensation raises a ball, which operates a valve to discharge accumulated water.

Float Valve.—An automatic valve where the admission of water into a tank or vessel is controlled by a lever attached to a hollow sphere, which floats on the surface and opens or closes the valve, according to its position.

Flock.—1. A lock of wool or hair; woolen or cotton refuse; old rags reduced to a degree of fineness by machinery, and used for stuffing upholstered furniture.

2. To roughen the surface of glass so as to give an appearance of being covered with fine flock.

Flogging Chisel.—In founding, a chipping chisel of large size, used in chipping off certain portions of a casting.

Flogging Hammer.—A medium sized sledge hammer such as used by erectors and machinists.

Flood.—An inundation; an unusually abundant flow of water in a stream; freshet or deluge; as, the *flood* burst the dam.

Flood Water.—A term used to denote the maximum rise of a body of water; as, from an inland freshet or the high tide at the sea coast.

Floor.—In mining; (1) a platform on which some specific operation, as sorting or dressing ores is carried on; (2) the bottom surface of a subterranean passage.

Floor Beam.—One of a series of beams used to support a floor.

Floor Chisel.—A wide rod chisel used by carpenters and plumbers for cutting through floors. It is usually 18 to 24 inches long, and must not be used for prying up boards, the *ripping chisel*, being employed for that purpose.

Floor Cloth.—A heavy canvas of hemp or flax, woven of extra width, printed in oil colors, and used as carpeting.

Flooring.—In carpentry, a layer of boards joined together and fastened to the floor beams; a platform.

Floor Joint.—In carpentry, a joint made between the sides of boards or planks which are continuous from end to end.

Floor Light.—A window in a floor.

Floor Plan.—The plan of a story of a house showing form, arrangement and dimensions of rooms, and thickness of partitions, positions of floors, etc.

Floor Stand.—A shafting support, consisting of a frame or pedestal upon which is mounted a pillow block bearing; means are generally provided for vertical adjustment, either by means of screws or by wedge keys.

Floss Silk.—The loose outer silk in the cocoon.

Flotation.—1. The act of floating; as, a vessel, etc.

2. The raising of capital which is necessary to start an industrial enterprise or corporation.

Flotsam.—In marine law, such part of a wreck of a ship and its cargo as is floating; opposite to *jetsam* goods which sink when cast into the sea and remain under water, and *ligan* goods, which are sunk attached to a buoy.

Flour.—The finely ground meal of wheat; especially the finer part of meal, separated by bolting through fine silk cloth or gauze.

Flour Bolt.—A machine for bolting or sifting the meal as it comes from a mill stone.

Flour Dresser.—A machine, cylindrical in form, for dressing flour, instead of passing it through bolting cloths.

Flour Gold.—In mining, a name sometimes given to gold occurring in very fine particles.

Flouring Mill.—A mill for making flour, usually of large size; distinguished from grist mill.

Flour of Sulphur.—In steam pipe fitting, a fine flour made of sulphur; this mixed with sal ammoniac and iron borings is used for making rust joints.

Flow.—To move by the power of gravity, and with a continual change of place among the particles or parts; as, a fluid, to change place or circulate; as, a liquid.

Flow Gate.—In founding, an opening whereby metal is permitted to escape from the mould in the operation of flowing.

Flow Head.—A cap or cover for the top of the casing in a bore hole, having a seat for the pump tubing, and side branches for the escape of gas, etc.

Flucan.—Soft clayey material found in a lode or along its sides.

Fluctuation.—Wavering; unsteadiness as, the fluctuations of the tides.

Flue.—A duct for the conveyance of air, smoke, heat, or gases; the central passage for smoke in a chimney or a side passage leading to the main passage.

Flue Blower.—A device wherein a jet of steam or compressed air is blown through the tubes or flues of a boiler to clean them from accumulated soot.

Flue Boiler.—A boiler in which part of the heating surface consists of *flues*, as distinguished from one having *tubes*.

Flue Brush.—A cylindrical brush of wire or steel strips used to clean the scale and soot from the interior of a flue or to lay bare the metallic surface of steam vessels; as, of boilers.

Flue Cinder.—Metal cinder or slag obtained in the process of iron manufacture.

Flue Cover.—Tiles of firebrick used to roof in the wing flues of a boiler set in brickwork. Removable cast iron plates or closely fitting tiles used to cover the back connection or uptake of various types of boilers set in brickwork.

Flue Plate.—In a steam boiler, a plate in which the ends of flues or tubes are fastened or set; also called *flue sheet*, *tube sheet* and *tube plate*.

Flue Scraper.—An implement having circular or spiral blades to scrape the scale from the fire surface of flues of steam boilers.

Flue Sheet.—The top sheet of the fire box or bottom of the smoke box to which the flues are secured.

Fluid.—A body whose particles move easily among themselves, and yield to the least force impressed, which tends to change the form of the fluid. Water, air, and steam are fluids.

Fluidity.—The quality of being fluid or capable of flowing; that quality of bodies which renders them impressible to the slightest force, and by which the particles easily move or change their relative position without a separation of the mass; a liquid, aëiform, or gaseous state; opposed to solidity.

Fluid Pressure.—In mechanics, pressure is transmitted by fluids *in all directions with an equal pressure*. The intensity of this pressure at any point within the fluid is proportional to the depth of the point from the surface of the fluid.

Flume.—A passage or conduit for the water that drives a mill wheel, or an artificial channel of water for hydraulic mining; also a chute for conveying logs or lumber down a declivity. In mining, an open or covered conduit for water, generally timber built, and carried on trestle work.

Flume Car.—A car designed to move on the edges of the side of a flume, and to use the current of water in the flume as a motive power.

Fluorine.—A gaseous element of a pale yellowish green color. Bromine, chlorine, fluorine, and iodine all greatly resemble each other, forming a group known as halogens, or producers of sea salt, from the nature of the compounds which they form directly with metals. Fluorspar or calcium fluoride is one of the best known natural forms of fluorine. This gas combines, usually with great violence, with all elements, except oxygen, nitrogen and chlorine.

Fluorspar.—A mineral of many different colors, white, yellow, purple, green, red, etc., often very beautiful—crystallizing commonly in cubes with perfect octahedral cleavage. It is used as a flux; also called *fluorite*.

Flush.—In the same line or plane; even; as, the flush front of a boiler. In weaving, threads which float over the surface of the fabric without intersection are said to flush; as, in tissue weaving.

Flush Bolt.—A screw bolt whose head is countersunk, so that it will not protrude from the surface.

Flush Front.—A term applied to a boiler, whose front is even with the brick work in which it is set, as distinguished from the overhanging or cutaway front.

Flushing Drains.—The act of drenching or washing pipe drains clear of refuse.

Flushing Tank.—A cistern or box for supplying water closets with a sudden rush of water.

Flush Joint.—A joint in which one part is grooved and the other tongued, so that when joined there will be no projection above the general surface.

Flute.—A moulder's sleeking tool, with a blade of semi-circular section, for dressing grooves in the mould.

Fluting.—1. A circular groove or furrow.
2. The act of making such a groove.

Fluting Gouge.—A gouge which is placed in a fluting lathe to cut flutes or scrolls upon columns or balusters. The flute proper is the vertical groove in a column or pillar, but the flute made by the gouge in the lathe is a spiral.

Fluting Machine.—One having grooved cylinders for fluting fabrics or sheet iron.

Fluting Plane.—A carpenter's plane for fluting wood.

Flutter Wheel.—A small water wheel placed at the bottom of a shaft so as to receive the impact of the falling water; its rapid movement produces a splashing which is suggestive of the fluttering of a fowl.

Flux.—1. In melting metals, an addition of some mineral, generally limestone or chalk, to the charge in the furnace, for the purpose of absorbing mineral impurities in the metal and running them off as the slag.
2. In soldering or brazing, a substance applied to the portions to be united, causing the solder to flow easily and adhere to the joint.

Fly.—In machinery, the loaded lever which actuates the screw of a fly press. The ball at the end of the lever acts as a *power accumulator*.

Fly Bars.—In printing, bars forming a vibrating frame, taking a printed sheet from the tapes and delivering it on the *heap*.

Fly Board.—In printing presses, the board on which the printed sheets are deposited by the *fly*.

Fly Drill.—In machinery, a drill having an alternately forward and backward motion controlled by a fly wheel, the driving power being applied by hand through a cord winding in reverse directions upon the spindle as it rotates backward and forward.

Flyer.—In spinning, the characteristic part of the bobbin and fly frame.

Flyers.—Stairs composed of straight flights, as opposed to winding stairs.

Fly Governor.—In steam engineering, a governor for regulating the speed of an engine, by the resistance of vanes revolving in air and oil—a principle employed in the Allen governor.

Flying Machine.—A machine designed to enable persons to navigate through the air.

Fly Press.—A hand screw press used for embossing, stamping and punching blanks from thin sheet metal. It has a cross arm with a heavy weight at one or both ends called a fly.

Fly Rail.—In shop work, a bracket which turns out to support the hinged leaf of a table.

Fly Shuttle.—In weaving, a shuttle traveling on wheels and propelled by a cord and driver.

Fly Wheel.—A wheel, in machinery, that equalizes its movements, or accumulates power for a variable or intermittent resistance; as, in a steam engine or a coining press.

Foam.—The aggregation of bubbles formed on the surface of liquids; froth; spume.

Foaming.—The act of priming in a boiler, whereby water is carried over into the engines with the steam.

Foaming in Boilers.—The mixing of steam and water in boilers accompanied by violent ebullition. The causes are—dirty water, trying to evaporate more water than the size and construction of the boiler is intended for, taking the steam too low down, insufficient steam room, imperfect construction of boiler, too small a steam pipe, and sometimes it is produced by carrying the water line too high.

F. O. B.—An abbreviation used for *free on board*, in commercial transactions, to

denote that goods are to be delivered free of cartage or similar charges at the freight house of the railway or steamship line which is to transport them.

Focal.—Pertaining or belonging to a focus; as, a focal point.

Foci.—The plural of focus.

Focus.—The point of concentration. In geometry, a term applied to certain points in the parabola ellipse and hyperbola, where rays reflected from all points concur or meet.

Fog Bell.—A bell located near rocks, shoals, etc., rung by machinery or waves, to warn mariners in foggy weather.

Fog Horn.—A sounding instrument used both on vessels and also on shore to warn shipping, during a fog or thick weather.

Folding Machine.—1. A machine for folding printed sheets, frequently having attachments for cutting, inseting or pasting.

2. A machine for pressing hollow ware out of sheet metal.

Folding Wedges.—Ordinary wedges, used in pairs, with their thin ends pointed in opposite directions, so that the upper and lower surfaces of the pair are parallel.

Folio.—(1) A book whose pages are made up of sheets that are folded but once, making four pages to the sheet; (2) the number of a page whether placed at top or bottom; (3) a wrapper or case for loose papers, engravings, etc.

Follow Board.—In founding, the same as mould board.

Follower.—1. A general term for a portion of a mechanism that is constrained to move in a certain direction by another moving piece termed the *driver*.

2. A toothed wheel or pulley driven by another wheel or pulley.

3. The plunger or lever arm, terminating in a roller, which bears upon the periphery of a cam, and is therefore given an intermittent reciprocating movement by the contour of the cam.

4. A "dolly" used in pile driving.

5. A local shop term for the loose plate or ring which secures the packing rings upon a piston, more generally known as junk ring.

Foot.—1. The lower part or foundation; the ground part; the bottom; as, of a column.

2. A measure of length; as, twelve inches make one (lineal) foot.

Foot Bellows.—A bellows worked by a treadle.

Foot Blocks.—In erecting, flat pieces of wood placed under shores or props to furnish a broader surface for them to rest upon.

Foot Board.—(1) The step on a steam fire engine, behind the boiler and slightly lower than the fire box, projecting out for the engineer to stand on; (2) the foot rest for the driver of a coach; (3) a narrow platform extending the length of cars having side entrances, notably in open street cars, and in compartment coaches of the European type.

Footing.—1. A spreading course at the base of a wall to give it stability.

2. The lower part of the slope of an embankment, used as a sea wall.

Foot Lathe.—A lathe operated by a treadle which is moved by foot power.

Foot Plate.—In a locomotive, the platform whereon the enginemen stand, at the rear end of the boiler. It also constitutes a part of the frame, being usually a heavy iron casting. Also called deck.

Foot Pound.—A term used to express the resistance equal to one pound moved upwards, one foot. The work done in lifting thirty pounds through a height of fifty feet is fifteen hundred foot pounds.

Foot Power.—Motion given to a machine by pressure exerted by one's foot on a treadle beneath it.

Foot Rule.—A rule or measure, twelve inches long.

Foot Screw.—An adjusting screw which forms a foot and serves to give a machine or table a level standing on an uneven surface.

Footstalk.—In machinery, the lower part of a millstone spindle, which rests in the bearing called the step.

Foot Stick.—In printing, a piece of wood or metal, tapering in shape, used for locking up forms.

Foot Valve.—1. The lowermost valve in a pump, through which the fluid is drawn into the working barrel or pump chamber.

2. An upward opening valve placed at the lower end of a pipe to prevent liquid from escaping therefrom.

Foot Wall.—In mining, that wall of a lode which is under the miner's feet; opposed to *hanging wall*.

Footway.—In mining, the ladders for descent and ascent of the shaft.

F. O. R.—An abbreviation for *free on rails*, signifying that all charges save those of railway transportation are paid by the vendors.

Force.—That which changes or tends to change the state of a body at rest, or which modifies or tends to modify the course of a body in motion.

Forced Draught.—In steam engineering, a system of artificial draught in which air is forced through the fires to accelerate combustion, thus increasing the boiler horse power.

Force Fit.—A shop term for that class of fit where a shaft is turned so much larger than its hole that a screw or hydraulic press or the application of heat to the female piece is necessary to get the pieces together.

Force Pump.—A pump employed to force water and other liquids above the range of atmospheric pressure, distinguished from lift pump, in which the liquid is elevated to run out of a spout. In a force pump, the water is forced out by a piston or plunger working against a pressure corresponding to the *head*, or elevation (above the inlet valves) to which the water is pumped.

Forebay.—The end of a mill race, next the wheel, or that part of a race above the flume or chute of a turbine water wheel.

Forebreast.—The working face of a mine.

Forecastle.—The accommodation in the forward end of a vessel for her crew; it refers to ancient days when there was a fighting castle at each end of a ship.

Forecooler.—In refrigeration, a supplementary condenser which consists of a coil or series of coils through which the compressed ammonia is made to pass before it enters the condenser proper. It is cooled by the overflow water of the condenser.

Foreman.—The first or chief man of a set of hands employed in a shop, or on works of any kind; a man who superintends the rest; an overseer.

Foremast.—The forward mast of a ship.

Fore Plane.—The carpenter's plane intermediate in length between the jack plane and the jointer or long plane.

Foresail.—In a square rigged ship, the lowest and largest sail on the foremast; in a schooner, the fore try sail.

Foreshortening.—Apparent decrease in length, owing to objects being viewed obliquely; thus a wheel, when seen obliquely, instead of appearing round, presents the appearance of an ellipse. A tall building appears shorter than it really is when seen obliquely from below.

Foresight.—In surveying, any forward reading of a leveling staff; a forward bearing taken by a compass.

Forge.—1. The structure upon which a smith's fire is built, consisting of hearth, tuyère, chimney, hood, and coal and water troughs or boshes. A forge is either fixed or portable; in the former case being built of iron or of iron and brick combined, in the latter case wholly of iron.

2. That portion of an iron works, where pig iron is converted into wrought by the processes of puddling and shingling, being subsequently rolled into puddled bar.

3. A smithy where work of a large kind is carried on, the wrought iron being formed into the desired masses by piling and welding under a steam hammer. At the present time, where mild steel is more commonly used, the chief work of the forge is done under large hydraulic presses of various types.

Forge Iron.—A piece or mass of metal formed by hammering.

Forge Train.—The set of heavy rolls between which the shingled bloom of puddled iron is rolled into puddled bar (muck bar). The rolls are grooved in a diminishing series, so as to reduce the bloom to a manageable bar, and are made reversing, if two high, or non reversing if three high.

Forge Work.—In iron work, wrought or malleable iron work as distinguished from founder's or cast work.

Forging.—The process by which iron or other metal is heated and hammered into shape. Such as the forging of tools, machine parts, etc.

Forging Machine.—A machine used in forming repetition work; it consists of two rows of graduated dies, hammers or stamps, between which the work can be drawn or swaged to desired dimensions.

Fork.—Anything like a fork in shape, also one of the parts into which anything is bifurcated or divided; a prong; a point; —a mine is said to be in fork, or an engine to have the water in fork, when all the water is drawn out.

Fork Center.—A center for driving woodwork in the lathe.

Fork Chuck.—A piece of steel entering the mandrel of a lathe, and terminating in a central point with two or more lateral teeth, for holding woodwork in turning.

Forked Connecting Rod.—In a steam engine, a connecting rod having a forked end, so that the crosshead is enclosed by it, instead of being itself enclosed, as in the solid form.

Fork Head.—The divided end of a rod which forms part of a knuckle joint.

Fork motion.—An early type of reversing gear, in which the ends of the eccentric rods were furnished with forks to embrace the pin or stud on the end of the valve spindle.

Fork Scriber.—A double pointed tool for marking small circles, in use by boiler makers.

Form.—1. The shape and structure of anything, as distinguished from the material of which it is composed; configuration; figure; frame; external appearance.

2. A mould or pattern upon which anything is fashioned.

3. Pages of type and engravings locked up in a chase or frame for the purpose of stereotyping, or type or stereotype plates arranged in their proper order in a chase for printing.

Former.—A pattern or mechanical device for shaping an article in manufacture; as, a templet, gauge, or die.

Formeret.—In building, an arched rib for a vault, which lies next to the wall, and parallel with it; a wall rib.

Formic Acid.—A colorless mobile liquid, of a sharp, acid taste, occurring naturally in ants, nettles, pine needles, etc.; and also produced artificially in many ways, as by the oxidation of methyl alcohol, by the reduction of carbonic acid, or the destructive distillation of oxalic acid. It is the first member of the *fatty acids* in the paraffin series and is homologous with acetic acid.

Formula.—An arithmetical formula is a general rule of arithmetic expressed by signs. Formulas or formulæ, express the plural of formula—a Latin word which means, simply, a form; hence a formula is a form of stating a problem. In chemistry, a group of symbols denoting a particular compound substance.

Formulæ.—The plural of formula.

Forward Eccentric.—The eccentric that imparts a forward motion to the valve gear.

Forward Projection.—In mechanical drawing, the projection of the object by means of parallel lines of sight, extended *forward* on the drawing instead of backward.

Fossil.—A cast of imbedded organic matter, found in stratified rocks; remains of organic origin naturally buried and preserved in form and sometimes in substance.

Found.—1. To reduce metals to liquid by fusion. To form into shape by casting; to melt or fuse; melt in a furnace and form into shape by casting; as, iron, steel and brass founding.

2. In printing, the process of type-casting or type-making.

Foundation.—The base upon which anything is erected. The lowest part of a building, usually below the street level.

Founders' Dust.—Charcoal, coal or coke, ground to powder and sifted for use in foundries.

Founders' Lathe.—A sort of lathe in which large cores are shaped to a cylindrical form, more especially for loam moulding.

Founding.—In glass making, the process of melting up the materials preparatory to blowing, etc.

Foundry.—A workshop where metals are founded or cast into moulds.

Foundry Brush.—A wire brush of varying forms used to clean castings after they are removed from the mould.

Foundry Crane.—A crane arranged in a moulding shop for the purpose of dealing with heavy moulds, lifting castings from the sand, etc.

Foundry Iron.—Pig iron suitable for making castings, but unsuitable for conversion into wrought iron.

Foundry Ladle.—In moulding, a vessel for carrying liquid metal from the furnace to the mould.

Foundry Pit.—A large and deep pit sunk in a foundry floor and lined with cast iron, or brickwork. Used to place the moulds, which have to be filled on end to produce sound castings.

Four Cycle.—In gas engines, the cycle of operations occupying *four strokes* or *two complete revolutions*. On the first forward stroke, an explosive mixture of gas and air is brought into the cylinder by suction, and compressed by the return or second stroke. The mixture is ignited just before the completion of this stroke. The resulting explosion produces a high pressure within the cylinder, which causes the *impulse* during the third or *power stroke*; on the return or fourth stroke, the products of the combustion are exhausted into the air, completing the cycle.

Fourdrinier Machine.—In paper making, the machine used in the manufacture of fine paper.

Four Jaw Chuck.—A device consisting of four jaws and used to grasp tools or work, in boring, drilling, or turning. It is an appendage to a lathe, or drill machine.

Fourneyron Turbine.—A radial outward flow water wheel, consisting of a fixed wheel with guide plates, in which the water acquires a rotary motion before entering the movable wheel, which it causes to rotate by pressure or reaction on curved vanes. The turbine rotates in a horizontal plane with a vertical spindle.

Fourth Dimension.—A term used in measurements; an extension of the conception of the three dimensions, length, breadth and thickness. The calculations relating to the fourth dimension belong exclusively to higher mathematics and are based upon assumptions rather than direct measurements. Thus, it is assumed, (1) that space is extended in length, breadth and thickness without limits, also without properties dependent either upon position or direction; (2) that this space is affected with such curvature that a right line shall always return into itself at the end of a finite and real

distance without losing in any part of its course that symmetry with respect to space on all sides of it, which constitutes the fundamental property of our idea of it.

Four Way Cock.—A cock so designed that water or liquids may be diverted into four different discharge pipes.

Four Wheel Switcher.—A small switching locomotive for use around docks, terminals, etc., having four wheels only.

Four Wheel Truck.—An arrangement of two pairs of wheels and axles upon an independent frame, the latter being pivoted on a pin fixed in the engine or car framing, and provided with various springs, links, etc., to permit of motion radially and horizontally.

Fowler, John.—Born 1826, died 1864. An English inventor, distinguished for the invention of the steam plow. In 1849 he invented a machine for making drains which was first worked by horses and later by steam; in 1858 he received the prize of £500 from the Royal Agricultural Society for his steam plow, which was improved in 1860 by the invention of the double engine tackles. He later entered upon the manufacture of his plows, taking out in all 32 patents for himself and his partners.

Fox.—1. Pertaining to that part of a lathe into which the dogs are inserted when articles to be turned are centered. Known also as a dog plate.

2. A small strand of rope.

3. A word widely used in combination as fox key, fox wedge, fox wood, etc.

Fraction.—A part of a thing; an expression for a definite portion of a whole.

Fracture.—1. The act of breaking or snapping asunder.

2. The appearance of a freshly broken surface, by which its texture is displayed; as, a compact fracture; a fibrous fracture.

Fragment.—A part broken off; a piece separated from anything by breaking; a small, detached portion.

Frail.—1. The property of being easily broken; of a fragile nature; structurally weak.

2. A flexible basket used in Oriental countries for shipping dried fruits, such as dates, figs and raisins.

Frame.—1. Anything composed of parts fitted and united together. Any kind of structure made for admitting, enclosing,

or supporting things; as, that which contains a window or door.

2. The skeleton of a structure, its essential parts put in their proper places and secured together; as, the frame of a house, ship, bridge, etc. In carpentry, a balloon frame is one made of light scantlings, only nailed together instead of being framed and pinned, so that its strength depends largely on the boarding nailed outside.

Frame Pedestal.—In railroad car construction, a casting secured to the frame of a truck and forming a jaw for holding a journal box.

Framer.—One who frames; as, a carpenter and framer.

Framer Chisel.—In carpentry, a stout, heavy chisel adapted for use in making mortises, etc.

Frame Work.—That which supports or encloses anything else; a system of frames.

Franklin, Benjamin.—Born 1706, died 1790. An American scientist, philosopher and statesman. He demonstrated the identity of lightning with electricity by his famous kite experiment (1752), and as a result invented the lightning rod; observing the waste of heat in open fire places he devised the Franklin stove; he constructed a lamp which anticipated the principle of the Argand burner; he improved the printing press, invented double spectacles, and made many other inventions that contributed to the advancement of mankind.

Franklin Institute System of Screw Threads.—The *Sellers* standard scale of screw threads, in which the characteristic is that the angle of the sides is 60°, and $\frac{1}{4}$ of the thread is flat at top and bottom; this varies from the Whitworth scale, in which the angle is 55° and $\frac{1}{4}$ of the thread is rounded at top and bottom.

Free Air.—Atmospheric air in its natural condition. Air compressors are usually rated according to the quantity of their air intake and the quality of their output; as, for instance, to compress 25 cubic feet of *free air* per minute and deliver it at a pressure of 150 lbs. per sq. in.

Freeboard.—That amount by which the deck is above the water line; where there are several decks the freeboard is measured from the uppermost full deck.

Free Burning.—Dry, bituminous coals which soon and easily arrive at the burning temperature. They swell considerably in coking and thus facilitate the access of air and the rapid and complete combustion of their fixed carbon.

Free Drainage.—In mining, a term applied to that effected by means of adits or drainage levels, in which the water flows away by gravitation, instead of necessitating pumping machinery.

Free Fall Drill.—A well boring tool used in a system where the tools are disengaged from the poles and permitted to fall nine to ten feet, and are then recovered, thus striking a heavier blow than is possible with the ordinary reciprocating drill.

Free Hand Drawing.—The act of making a drawing without guiding instruments or measurements, depending on the hand and eye alone; a sketch.

Freestone.—In architecture, a name applied to any species of sandstone that can be easily quarried.

Freeze.—To congeal or change from a liquid to a solid state, by the abstraction of heat. Water freezes at 32° above zero Fahrenheit, while mercury freezes at 40° below zero.

Freezing Mixture.—A combination of snow and ice, used in grading a thermometer to locate the freezing point of water; the snow and ice unite and form a liquid and doing this, absorb latent heat from surrounding objects or the atmosphere, thus lowering the temperature.

Freezing Point.—Correspondent with 32° Fahrenheit or 0 Centigrade, and is the temperature at which water will pass into a solid mass.

Freight.—1. That with which anything is laden for transportation; lading cargo, especially of a ship.

2. That which is paid for the transportation of goods and merchandise.

Freight Car.—A railway car for transporting goods of all kinds.

Freight Service.—That organized department of a railroad that controls the movement of merchandise, and is concerned with the various details connected therewith.

French Chalk.—A variety of soapstone, of soft soapy feeling, used for lubrication.

French Curves.—Curved figures of varying forms, which are employed by

draughtsmen in delineating elliptic or parabolic curves. Sometimes termed *scrolls*.

French Polish.—A polish composed of grain alcohol 700 parts, copal varnish 15 parts, gum arabic 7 parts and shellac 30 parts, used in giving a glossy smoothness to woodwork.

French System of Weights and Measures.—The metric system, as legalized by special act of the United States Congress; the *metre, litre, gramme*, etc., are increased or decreased by the following words prefixed to them:

Milli expresses the 1,000th part.			
Centi	"	"	100th "
Deci	"	"	10th "
Deca	"	"	10 times the value.
Hecto	"	"	100 "
Kilo	"	"	1,000 "
Myria	"	"	10,000 "

Fret.—1. An ornament consisting of small fillets intersecting each other at right angles.

2. The agitation of the surface of a fluid; as, when fermenting or boiling.

Fret Saw.—1. One having fine teeth and a long slender blade adapted for cutting ornamental patterns and devices.

2. An endless band saw of the same type, mounted on a stand and worked by a treadle.

3. A keyhole saw.

Fretwork.—Ornamental work consisting of a series or combination of frets, especially, work in which the design is formed by perforation.

Friable.—Easily broken or crumbled; easily reduced to powder; as, pumice.

Friction.—The resistance existing between two bodies in contact which tends to prevent their motion on each other; according, as the motion is over a surface or on a line, it is further designated as *sliding* or *rolling friction*. It is partly due to the natural adhesion of one body to another, but chiefly to the roughness of the surfaces in contact. The object of lubrication is to form a film of oil between two metallic surfaces, the friction of solids on fluids being much less than that between solids.

Frictional Head.—In hydraulics, increase or decrease of the pressure of fluids in piping due to their friction upon the sides thereof. Thus, in forcing water through pipes, the friction within the mains augments the head to be overcome by the pumps, while the friction of water on the sides of a flume, will, to a certain extent, destroy the head of water available for power. Also called *dynamic head*.

Frictional Loss.—In an engine or machine, the energy dissipated in overcoming the friction or internal resistance of the mechanism.

Frictional Resistance.—That proportion of the total load on a machine due to external friction which has to be overcome; as, the friction of the rails and atmosphere upon a locomotive.

Friction Clutch.—A means for coupling or disengaging two lengths of shafting in the same line while in motion. A simple method is by means of friction cones, but for larger powers, a system of expanding shoes controlled through toggle joints by means of a lever or handwheel; the expansion of the shoes against the interior surface of a drum, giving great frictional resistance. The gradual application or withdrawal of the clutch enables the shaft to be started or stopped without shocks.

Friction Cone.—A friction coupling or clutch, in which male and female cones are employed.

Friction Coupling.—A coupling in which the friction between the two halves causes the two parts of the shaft to revolve together. A common type consists of an internal and an external cone which fit into each other.

Friction Draft Gear.—A draw gear in which the usual springs are assisted by devices which dissipate the shocks and jars of traction by means of friction.

Friction Drive.—In an automobile, friction gearing used for transmission instead of spur wheels.

Friction Gearing.—Any combination of elements used to transmit power or motion by frictional contact. Sometimes used in a restricted sense for *friction wheels* alone.

Friction Hoist.—A sort of winch or warping drum, made in a variety of patterns, in which a shaft is driven continuously by a belt or motor, and the hoisting part is actuated from this by friction pulleys or wheels.

Friction of Belts.—Belts derive their power to transmit motion from the friction between the surface of the belt and the pulley, and are governed by the same laws as in friction between flat surfaces. The friction increases regularly with the pressure; the more elastic the surface, the greater the friction.

Friction Pulley.—A friction wheel in which the surface of the rim is in contact with the rim surface of another pulley; usually the driving pulley is faced with wood, the driven pulley being smooth iron. Such pulleys are much used in lumber working machinery.

Friction Roller.—A small wheel or drum used to support the shaft of a larger wheel, the rotation of the roller abolishing sliding friction between the axle and the bearing.

Friction Tight.—A mechanical fit, joint or union between two surfaces so close that any motion given to one part will be transmitted to the other without the interposition of a key or other locking device.

Friction Wheels.—Wheels for the transmission of power by frictional contact; made as spur wheels and pinions, or bevel and mitre wheels, the teeth being replaced either by compressed paper fillers, leather or other lining, or plain metallic surfaces.

Frieze.—1. In architecture, that portion of the entablature which is between the architrave and the cornice, though in modern architecture, the frieze is introduced immediately below the cornice.

2. A thick, coarse woolen cloth used in the making of outer garments.

Friezing Machine or Edge Moulding Machine.—A machine designed to cut mouldings on the edge of woodwork.

Fringe.—1. An ornamental appendage to the borders of garments or furniture consisting of loose threads.

2. Something resembling fringe; an open, broken border; a border; a confine.

Frit.—1. In glass making, a calcined mixture of sand and fluxes which is melted in crucibles to make glass.

2. In ceramics, a composition used in the manufacture of porcelain.

3. To partially fuse; to decompose.

Frit Brick.—A block of glass making material prepared for further fusion by a first burning or melting, which has been carried to the point where the silica begins to act upon the bases.

Frog.—1. In railways, a forging or casting, forming the apex or point where two rails intersect at an acute

angle. When used at a crossing to unite the rails, it is called a *cross frog*.

2. In a brick, a hollow or recess formed upon one surface for the reception of the mortar. In *handmade* bricks, there is usually a frog on one side only; *wire cut* bricks have no frog; *machine moulded* bricks have a well marked frog, frequently on both sides.

Front.—Foremost or forward part; the opposite of rear; as, the front bench or the front steps.

Front End.—In a locomotive, a term for the smoke box, chimney, blast nozzle, spark arrester, etc., collectively.

Front Rake.—The clearance given to a cutting tool for lathe or planer, whereby the front or point departs from an angle of 90°.

Front Scale.—A graduated scale fitted to a typewriting machine, by means of which the spacing of margins or indentation of paragraphs is regulated.

Front Tool.—A turning tool for operating up longitudinal surfaces, carrying along a cut parallel with the lathe bed. More especially a tool for use with brass, etc., corresponding in shape to the common diamond point tool.

Frost.—Dew which has frozen through the night on account of the temperature having fallen to or below the freezing point. Also called *hoarfrost*.

Frow.—A cleaving tool, with a wedge shaped blade, used by coopers in splitting staves for casks, etc.; also used in making shingles and clapboards. The handle is at right angles to the back of the blade and is held in the left hand, while the mallet which drives the edge into the log is held in the right hand. Also called *froe* and *frower*.

Frue Vanner.—In mining, a moving, inclined, endless apron on which ore is concentrated by a current of water; a kind of *buddle*.

Frusta.—The plural of *frustum*.

Frustum.—The base of a cone or pyramid, the point being cut off by a plane; a pyramidal or conical solid enclosed between two planes.

Ft.—Abbreviation for foot and feet.

Fuel.—Any substance which will, by burning, produce heat and light; as, coal, wood, oil, gas, etc.

Fuel Economizer.—In a steam plant, an apparatus for saving fuel by using the waste heat of a furnace flue to heat the feed water. It commonly consists of a series of pipes, placed in the chimney flue, and having mechanical devices for cleaning the exterior of the pipes.

Fuel Gas.—A producer gas, suitable for use as fuel for internal combustion engines.

Fuel Oil.—Any combustible oil or like substance which is used for the production of heat; as, petroleum and its products.

Fuel Oil Burner.—An engine so constructed that the heat for steam making is produced by burning a cheap unrefined petroleum.

Fulcrum.—A prop or support; that by which a lever is sustained or about which it turns in lifting or moving a body; in the operation of the lever, three points are to be considered; viz.: (1) the fulcrum or point about which the bar turns, (2) the point where the force is applied, and (3) the point where the weight is applied.

Fullfill.—1. To fill up; to make full or complete.

2. To accomplish, or carry into effect; as, an intention, promise and the like; to complete by performance.

Full.—1. Containing or having within its limits all it can hold; not empty or vacant; as, a cask full of water.

2. A workshop term, denoting that a certain measurement is slightly in excess of a stated nominal size. A measurement larger than a nominal size by an amount too small to be measured by the rule but perceptible to the calipers.

Fuller.—1. In blacksmithing, a die, a half round set hammer.

2. One whose occupation is the fullering or dressing of cloths.

Fullering.—The caulking of a steam boiler by a round nosed tool; caulking being executed usually by a sharper instrument; the washing and scouring of cloth; as, with fuller's earth.

Fuller's Earth.—A variety of clay, compact but friable, oily to the touch, and of various colors, usually with a shade of green. It is useful in scouring and cleansing, as it imbibes grease and oil.

Fulling Mill.—A mill for fulling cloth by means of pestles or stampers, which

alternately fall into and rise from troughs where the cloth is put with the fuller's earth or other cleansing materials.

Full Way Valve.—A sluice or gate valve for steam, etc., contrived to give a full bore opening of the same area as the pipe.

Fulminate of Mercury.—A violent explosion made by addition of alcohol to a solution of mercury in nitric acid. It explodes with slight friction or a light blow, and is used for detonators, gun caps, etc.

Fulton, Robert.—Born 1765, died 1815. An American engineer celebrated for building the first successful steamboat in America. He early invented a machine for sawing marble (1794), and later machines for spinning flax and making rope; he drew plans for a cast iron aqueduct (1796); wrote an important work on canal navigation the same year; experimented on submarine explosives (1797); and successfully designed and built a submarine boat (1801); he experimented with steamboat building (1806) resulting in the building of the "Clermont" by which steam navigation became a commercial success; and in 1814, he constructed the first steam frigate for the U. S. Navy.

Fumble.—To manage awkwardly; to crowd or tumble together.

Fumes.—The matter expelled from metallic substances when being unduly heated or burned; smoke or exhaled vapors.

Function.—1. Performance; the act of executing.

2. A quantity in mathematics so connected with another quantity, that if any alteration be made in the latter there will be a consequent alteration in the former. The dependent quantity is said to be a function of the other. Thus, the circumference of the circle is a function of the diameter.

Funicle.—A small cord; a fiber.

Funicular Action.—The force or action exerted by a rope in drawing together the supports to which its ends are fastened, when acted upon by forces applied in a direction transverse to the rope; as, in an archer's bow.

Funicular Machine.—An apparatus for illustrating certain principles in statics, consisting of a cord or chain attached at one end to a fixed point, and having the other passed over a pulley and sustaining a weight, while one or more weights are suspended from the cord at points between the fixed support and the pulley.

Funicular Polygon.—The figure assumed by a rope supported at its extremities and suspending weights at various points.

Funicular Railway.—A railroad for steep gradients, operated by means of a rope, in which the weight of the descending cars counterbalance those ascending; in use largely in Switzerland.

Funnel.—1. An implement with a wide mouth and tapering spout, usually made of tin or copper, for changing liquids or powdered material from one vessel into another with a narrow throat, sometimes called tunnel.

2. The smokestack of a steamship.

Funnel Draught.—In marine practice, a term applied when the motion of the air through the fuel is occasioned solely by the difference in weight between the column of heated gases in the funnel, and a column of outside air of the same height. Also called *natural draught*.

Fur.—1. To remove scale; as, from the inside of a boiler.

2. To nail strips upon; as, joists, in order to secure a level surface for lathing.

Furbish.—To make bright by rubbing, polishing, etc.

Fur Cutter.—A machine or implement for removing fur fibers from a skin.

Furlong.—A measure of length, the eighth of a mile; forty rods.

Furnace.—1. In a steam boiler, that part designed for the burning of the fuel. The principal parts and appendages of a furnace are as follows: (1) *The furnace proper* or fire box, being the chamber in which the solid constituents of the fuel and the whole or part of its gaseous constituents are consumed; (2) *the grate*, which is composed of alternate bars and spaces, to support the fuel and to admit the air; (3) *the dead plate*, that part of the bottom of the furnace which consists of an iron plate simply; (4) *the mouth piece*, through which the fuel is introduced and often some air. The lower side of the mouth piece is the dead plate.

2. In founding, the cupola or stack wherein the iron is melted.

Furnace Casing.—The iron plates of which the exterior of a blast furnace is composed.

Furnace Man.—In founding, the attendant on the cupola.

Furnace Ventilation of Mines.—Coal burning in a basket or similar grate underneath the upcast shaft, to create a column of heated air, thus causing a draught through the mine.

Furnish.—To provide with things necessary for use; to supply; to equip.

Furniture.—That which furnishes, or with which anything is furnished or supplied; fitting out; supply of necessary, convenient articles for any business or office.

Furring.—1. Becoming incrustated; as, a steam boiler with scale.

2. Double planking the sides of a vessel; as, in ship building.

3. Pieces of timber used for double planking.

4. In building, the lining of boards or scantlings, upon which plaster or cement is placed to exclude moisture.

Furrow.—A trench in the earth cut with a plow; in milling, the grooves in the face of a millstone; in mechanics, grooves, hollows and wrinkles in metals.

Fuse.—1. In mining, a detonating contrivance, that can be arranged to cause explosion, after a determinate period, or on concussion.

2. A textile cord having a combustible chemical core, used as a train to ignite explosives. It burns at rates varying according to type.

Fusee.—1. A cone pulley used in watch making; it is connected with the barrel

of the mainspring by a cord or chain, which as it unwinds from one, coils upon the other, and vice versa, thus regulating the action of the mainspring.

2. A name applied to a quick burning friction match.

Fusee Windlass.—In watchmaking, the cone or conical part of a watch or clock, round which is wound a chain or cord, that connects with the barrel containing the main spring, whose action it equalizes.

Fusible.—Capable of being melted or liquefied by the action of heat.

Fusible Metal.—An alloy of lead, tin and other metals easily fused at low temperatures, such as is employed for the filling of safety plugs in boilers.

Fusible Plug.—In steam engineering, a piece of easily melted alloy, placed in one of the sheets of a steam boiler and intended to melt and allow the blowing off of the steam in case of low water.

Fusing Point.—The temperature at which metals, or metallic alloys, melt and become liquid.

Fusion.—The act of melting; the operation by which solid bodies become fluid by the application of heat instead of by the use of a solvent.



G.—The seventh letter of the English alphabet.

g.—A symbol used to represent the acceleration due to gravity at the earth's surface.

Gab.—The hook at the end of an eccentric rod opposite the strap. The word is derived from a Greek term meaning mouth or gap.

Gabbro.—A name of Italian origin applied to an eruptive rock, of structure resembling granite, but composed of the same minerals as basalt. Gabbro is a peculiar crystalline granular rock, of perplexing variety, which has evidently been formed in the deeper part of the core of a volcano.

Gable.—In architecture, the end wall of a building; as, distinguished from the front or rear side; it is usually triangular in shape.

Gable Finish.—In architecture, the moulding or cornice around a gable end, usually corresponding to that employed on the eaves of a building.

Gable Miter.—In sheet metal working, the miter of an inclined moulding in cornice work.

Gab Lever.—A lever with a gab or gap in it, fitting over a pin in the valve motion; used with a disconnecting valve gear.

Gad.—A mining tool, with a diamond point and six inches to a foot in length, used to break up rock or coal; intermediate between the drill and the wedge.

Gadding Machine.—In quarrying, a species of drilling machine by which holes are made for breaking out beds of stone by plugs and feathers.

Gad Tongs.—A variety of smiths' tongs, with curved jaws, and the lips curved at right angles to them, thus serving to hold a bolt by its shank, the head of it being cleared by the curve of the jaws.

Gaff.—1. The spar upon which the upper edge of a fore and aft sail is extended.

2. An iron hook with which seamen pull large fish into their ships, also a barbed spear with a handle, used by fishermen in salmon fishing, etc.

Gagger.—In moulding, L-shaped pieces of cast iron, used to support the projecting portions of the sand in a mould.

Gag Pot.—A term sometimes used for the dash pot of a Corliss engine.

Gain.—1. In building, a beveled shoulder upon a binding joist for the purpose of strengthening a tenon.

2. In carpentry, a groove or notch.

3. In mining, a cutting or channel made in the sides of an underground passage.

Galena.—A bluish gray mineral, from which most of the lead of commerce is obtained; native sulphide of lead; used in the form of a powder to glaze pottery.

Gall.—1. In stone cutting, a hollow resulting from change in the direction of cutting.

2. A locality made barren by the wasting away or exhaustion of the soil.

Gallery.—In mining, a subterranean passage, a level; a drift.

Galley.—1. A light fast rowing boat pulled by four or six oars.

2. The kitchen aboard ship.

3. An antique warship propelled by oars.

4. In printing, a tray of wood or brass, for holding type which has been set.

Gallium.—A rare metal found in certain zinc ores; it resembles aluminum in its properties. It has a very low melting point, 86° F.

Gallon.—An American and English measure of various capacities; the standard of the United States contains 231 cubic inches, and at 62° F. weighs 8.33 pounds. One cubic foot contains 7.48 gallons. A cylinder 7 inches in diameter and 6 inches high holds 1 gallon very nearly, or 230.9 cubic inches. The British Imperial gallon contains 277.274 cubic inches = 1.2 U. S. gallon, or 10 pounds of water at 62° F.

Galloway Boiler.—In the Galloway boiler, the flue is sustained and stiffened by the introduction of numerous conical tubes flanged at the two ends and riveted across the flue. These tubes are in free communication with the water of the boiler, and besides acting as stiffeners they also serve to increase the heating surface and promote circulation.

Galloway Tubes.—Cross water tubes of tapering section fitted into the fire box furnace flue of a boiler.

Gallows Frame.—In carpentry, a frame consisting of two upright posts and a cross beam on the top, also the frame supporting the beam of an engine.

Galvanized Iron.—Sheet iron covered by a coating of zinc for protection from rust.

Gamboge.—A gum resin of a yellow color; obtained from a tree found in Siam; it is used as a pigment in water-color painting, and as a coloring matter in spirit varnishes.

Gambrel Roof.—A hipped roof; a mansard or curb roof.

Gang.—1. A number going in company; hence, a company, or a number of persons associated for a particular purpose.

2. A combination of similar implements; as, a gang of saws.

Gang Boss.—The leader or foreman of a number of workman, who is also a working foreman receiving his instructions from a *general foreman*.

Gang Die.—A die or bolster for a multiple punching machine, in which there are a number of holes to accommodate several punches.

Gang Drill.—A set of drills in a machine operated together from one shaft. Also called a multi-spindle drill.

Gang Edging Machine.—A machine used to trim planks to width, in which two, three or more circular saws are set at stated distances upon a common arbor or spindle.

Ganger.—The leader of a small body of workmen, especially the working foreman of plate layers or trackmen; a section foreman.

Gang Mill.—A saw mill in which a number of saws are so placed as to make a number of kerfs simultaneously.

Gang Plank.—A gangway to reach a ship from the wharf.

Gang Plow.—A plow in which there are a number of shares to cut several furrows at once.

Gang Pump.—A two or three plunger power pump of the ordinary type, the pumps being worked either by eccentrics or cranks. Such pumps are usually belt driven or else by gearing, off a small engine.

Gang Saw.—Several saw blades placed parallel in one frame and all acting together so that an entire log may be ripped into lumber at one passage along the ways.

Gangue.—The non-metallic element in a lode or vein; the worthless rock in ore; vein stone.

Gangway.—The entrance to a ship's deck through the bulwarks; a passage way.

Ganister.—A refractory rock; a kind of sandstone, used as a furnace lining.

Gantry.—A staging or scaffolding used to support traveling cranes and similar structures; also spelled gantry.

Gantry Crane.—In machinery, an overhead traveling crane carried on trussed beams or girders; as, in the erecting department of a machine shop.

Gap.—An opening made in anything by breaking or parting. To stop a gap is to secure a weak point; to repair a defect.

Gap Bridge.—The bridge piece employed to close the gap in a lathe bed.

Gap Lathe.—One with an opening in its bed near the fast headstock, to permit of a larger object being swung; this opening is closed when necessary by a loose piece called the *bridge*, which has the same section on its upper surfaces; as, the lathe bed proper.

Garage.—1. A shed or stable wherein motor cars are stored.

2. The act or business of providing storage accommodation for motor vehicles.

Gargoyle.—In architecture, a spout projecting from the roof gutters of buildings, especially of ancient ones, carved grotesquely.

Garnet.—1. A common mineral having many forms, one or two of which are valued as gems, on account of their resemblance to the ruby.

2. A tackle for hoisting cargo in or out of a ship.

Garnet Paper.—A paper made of a mixture of pulp and *garnet*, used for the manufacture of black boards and erasable or slate books.

Gas.—That fluid form of matter which is elastic and tends to expand indefinitely. A term used at first by chemists as synonymous with air, but since restricted to fluids supposed to be permanently elastic; as, oxygen, hydrogen, etc., in distinction from vapors, as steam, which becomes liquid on a reduction of temperature.

Gas Buoy.—A buoy carrying a light, and containing a reservoir of Pintsch or other compressed gas to supply it.

Gas Burner.—That part of a gas fixture where the gas is burned as it escapes from one or more minute orifices.

Gas Check.—A ring or plate at the rear of the charge chamber in some kinds of breech loading ordnance; such as Krupp's, etc.. It is designed to close the rear aperture, and prevent the escape of gas rearward.

Gas Coke.—The coke which is produced in gas retorts by the distillation of coal for the production of gas.

Gas Cylinders.—Strong portable steel vessels, of cylindrical shape, in which various gases are stored under high pressure.

Gas Engine.—An internal combustion motor, which derives its energy from the explosion of a mixture of illuminating or producer gas with atmospheric air. The term gas engine is also applied to those using gasoline as fuel.

Gaseous.—Partaking of the nature of gas; that is, possessing no natural boundaries or form, but accommodating itself to the shape of the vessel containing it, and expanding to the dimensions of any space, no matter how great.

Gaseous Mixture.—In gas engines, the charge: *i. e.*, gaseous or combustible mixture brought together in the cylinder or explosion chamber of a gas engine, usually consisting of from nine to twelve parts air to one of gas.

Gaseous Steam.—In steam engineering, a term applied to highly *superheated* steam. When saturated steam, *i. e.*, steam having a temperature due to its pressure, is superheated, its pressure remains the same, but the steam does not change to the gaseous state until the temperature is elevated considerably beyond that of saturation. Steam thus highly superheated is known as *gaseous steam* or *steam gas*.

Gas Fitter.—One who puts up gas fixtures.

Gas Fixture.—One of the ornamental fittings or appendages at the extremity of the pipes which conduct gas from the meter to the different apartments of a building; a bracket or chandelier for gas, including a stop cock and burner.

Gas Furnace.—A smelting or other furnace, which is fixed with gas produced in a separate arrangement termed the converter. This system is worked in connection with regenerative stoves, and besides being economical in fuel cost, has the advantage of easily controllable heat.

Gas Generator.—1. An apparatus in which gases are generated for laboratory or commercial use, such as that in which chlorine gas is produced for gold recovery from the ores.

2. That part of a gas machine or producer, in which the gas is made from the raw materials, being subsequently scrubbed and purified in other stages.

Gas Governor.—An apparatus for equalizing the flow of gas, or the pressure under which it escapes when burning.

Gas Holder.—In gas works, the large reservoir in which common illuminating gas is kept under pressure and stored for use.

Gas Vein.—In mining, an ore bearing fissure that does not extend into other strata, opposed to a fissure vein, which is the result of deep seated movements.

Gasket.—1. The plaited hemp used for packing a piston; as, of a pump or the stuffing box of an engine.

2. Any ring or washer of packing.

3. A thin sheet used in making joints.

Gasket Chisel.—The caulking tool employed by plumbers and others to pack spun yarn and lead gaskets into the bells of pipes. The same as yarning tool.

Gas Light.—Light produced by the combustion of carbureted hydrogen or other gases.

Gas Machine.—A self contained apparatus for generating illuminating gas from liquid hydrocarbons, etc. Used in connection with small installations; as, at isolated institutions, mansions, etc.

Gas Main.—1. In gas manufacture, the principal supply pipe laid from a gas works through a district, supplying branch mains for the side thoroughfares, these latter in turn communicating by supply pipes to the various buildings.

2. In a blast furnace, the trunk or conduit which receives the waste gases from the upper part of the various furnaces, conducts them to the stoves, and thence to various plants for ammonia recovery, etc.; the gas being sometimes used under boilers to generate steam for blowing engines, hoists and the like, or else, in more modern practice, used in large gas engines.

Gas Meter.—A machine for the measurement of illuminating gas, of which there are two kinds, the *wet meter* and the *dry meter*. The unit of quantity for gas is the cubic foot.

Gasoline.—A highly volatile product formed by the distillation of crude petroleum, also by the distillation of bituminous coal. It is used as a fuel and also for the carbonation of air, water gas, etc.

Gasoline Burner.—A vaporizing burner; the heat of the flame gasifying its own fuel, as it passes through a coil on the way to the tip.

Gasoline Engine.—An internal combustion engine whose fuel is derived from gasoline or light petroleum hydrocarbons. Gasoline engines may be divided, according to their principle of operation, into two general classes: the *two cycle* and the *four cycle*.

Gasometer.—An apparatus for measuring or holding gas; a gas holder or reservoir; usually a cylinder closed at one end and having the other end immersed in water, in which it is made to rise or fall, according to the volume of gas it contains, or the pressure required.

Gas Pipe.—Buttwelded iron pipe, such as is used for making the connection

between the cast iron mains and the branch pipes within a building.

Gas Pliers.—Strong pliers with curved serrated jaws by means of which a gas pipe can be held. The jaws are made to a double or treble curve to suit various sizes of pipe and a burner nipple, while one handle is formed as a screw driver and the other as a claw.

Gas Pump.—A small pump used in some varieties of gas engines to compress the charge and force it into the cylinder. In others, a pump operated at will from the engine to accumulate a storage of compressed gas and air.

Gas Retort.—A form of retort used to contain the coal and other materials used in the manufacture of gas.

Gassing.—In textile manufactures, the process of singeing the fabric with a gas flame to remove filaments, etc., from the surface.

Gassing Frame.—A machine for winding and unwinding yarns, thread, etc.; used in gassing.

Gas Trap.—A device used in connection with drains, etc., which, permitting the free flow of liquids with any solid matter that they may carry, prevents the passage of gas or air in either direction.

Gas Turbine.—A type of internal combustion motor in which the gases of explosion are sought to be utilized by doing work upon the blades of a turbine instead of on a piston.

Gas Valve.—A stop valve for gas mains any differences in its construction from ordinary stop valves being due to attempts to prevent the gas from coming into contact with moving parts.

Gas Water.—Water through which coal gas has been passed to purify it; called also gas liquor and ammoniacal water, and used for the manufacture of sal ammoniac, carbonate of ammonia, etc.

Gas Well.—A hole or orifice from which natural gas flows or is pumped from beneath the earth's surface.

Gas Works.—A manufactory of gas, with all the machinery and appurtenances; a place where gas is generated for lighting cities.

Gate.—1. In founding, an opening into a mould, for pouring in the molten metal, or for other purposes; also called flow gate, gate channel, feeding gate, skimming gate, etc.

2. The piece of waste metal remaining in the gate after the casting is made.

3. In mining, the same as a gateway and gate-road.

Gaters.—In moulding, small trowels or curved pieces of sheet metal used to cut the gate channels in moulds.

Gate Shutter.—In founding, a sort of spade used to close the gate when the mould is full to divert the molten iron into other moulds.

Gate Stick.—In moulding, a wooden pin inserted into the mould before ramming, to form the channel for the gate.

Gate Valve.—A *sluice valve*; one having two inclined seats between which the valve wedges down in closing, the passage through the valve being in an uninterrupted line from one end to the other, while the valve, when opened, is drawn up into a dome or recess, thus leaving a straight passage the full diameter of the pipe.

Gateway.—In coal mining, an underground road, connecting a stall or working place with a main road; a gate.

Gate Wheel.—In a hydraulic turbine of the inward flow pattern, a toothed wheel controlling the various gates by which the opening and closing of the ports are effected. A small pinion gearing into the gate wheel is revolved by means of a key or crank.

Gather.—To bring together; to collect; as, a number of separate things, into one place, or into one aggregate body; to assemble.

Gathering Hoop.—In coopering, a temporary hoop used to draw in the ends of barrel staves before adjusting the permanent hoop.

Gatling Gun.—A machine gun, invented by Dr. R. J. Gatling. It was the first successful firearm of this type. It is mounted on a gun carriage or tripod and operated by turning a crank, the cartridges being fed in from a magazine.

Gauge.—A measure; a standard of measurement; an instrument to determine dimensions or capacity.

Gauge Board.—In plastering, the board upon which the materials are gauged or mixed.

Gauge Cock.—The small cock by which a pipe leading to a gauge is opened or closed.

Gauge Glass.—In a steam boiler, a brass mounting fitted with a glass tube to show the water level, and cocks to control steam, water and drain.

Gauge Pressure.—The tension of a fluid as registered upon a pressure gauge, to which 14.7 lbs., or the weight of the atmosphere, must be added in order to ascertain the absolute or true pressure.

Gauntleted.—A term applied to railway tracks, when by crossing the two inner rails, two lines of rail occupy the width of one, to enable a double track to cross a bridge or traverse a single track tunnel without the interposition of switches.

Gauze.—A very thin, slight, transparent stuff, of silk or linen.

Gauze Wire.—Wire cloth made of very small wire and fine meshes. See wire gauze.

Gear.—1. A related assemblage of mechanical parts, to produce some desired effect; as, valve gear, reversing gear, pump gear.

2. The appliances and implements necessary or usually provided to carry on a certain operation; as, spare gear, fishing gear.

3. The fittings supplied to a boat, such as masts, sails, oars, boat compass, etc., or more specially, the appurtenances belonging to the business in which a boat or craft may be engaged; as, trawling, seining, etc.

4. In a restricted and local sense, a toothed wheel. This is a wrong use of the word, as gear is a plural or collective noun.

Gear Box or Gear Guard.—A box or covering fixed over the gears of a machine to prevent anything dropping between the teeth and wrecking the machine.

Gear Case.—In an automobile, the casing or box in which the change speed gearing is located.

Gear Cutter.—A milling cutter, specially formed, to shape teeth of cog wheels; a gear cutting machine.

Gear Cutting Machine.—One for making cog wheels, by cutting out the *interdental* material: i. e., between the teeth

Geared Locomotive.—A variety of engine used for working on heavy inclines. Bevel pinions, mounted upon their shafting, work into bevel wheels on the side of the truck wheels, so that every wheel in engine and tender becomes a driving wheel.

Gear Guard Band.—In hoisting engineering, an iron strap or band, arched over the gearings to protect them from receiving or doing injury.

Gearing.—The same as *gear*, but more usually restricted to mean some arrangement of spur or worm wheels, whereby motion is transmitted. The employment of gear is due to this restricted use of the term; gearing being an assemblage of toothed wheels.

Gear Moulding Machine.—In moulding, a special machine for moulding toothed wheels, in which a radial arm carries the pattern consisting of two or three teeth only, forming the mould by repeated impressions of the pattern.

Gear Pump.—More properly geared pump. A power pump or system of pumps driven by spur gearing from the source of power.

Gear Shaper.—A shaping machine used to cut out cog wheel teeth, the tool being guided by a pattern or former. This type of machine is more frequently employed to shape the teeth of bevel wheels.

Gear Wheel.—A toothed wheel; a cog wheel.

Gelatine, Gelatin.—A transparent, tasteless substance, obtained by the action of boiling water on animal connective tissues, such as cartilages, ligaments, tendons, etc., also hoofs, horns and fish scales. The coarser quality is called *glue*; that obtained from the skin and finer membranes is known as *size*, and the air bladders and other membranes of fish produce the best grade, known as *isinglass*.

Gelatine Dynamite.—Nitrogelatine (guncotton steeped in nitroglycerine) compounded with wood meal.

Gelatine Sensitized Paper.—A photographic paper covered with a compound made chiefly from bromide of silver, put on in a layer of gelatine.

General Manager.—The administrative head of a corporation or large firm; the

chief executive employe; whose duty it is to initiate and maintain policies and the broad lines of administration. The general manager has charge of all the departments.

Generate.—To produce, especially by a vital or chemical process; as, the generation of steam in a boiler; to cause to be; to bring into life and activity.

Generating Surface.—1. In steam engineering, the entire superficies of a steam boiler exposed to the flame and incandescent gases on the one side, and to the water upon the other. Also called *heating surface*.

2. In smelting and founding, the total area of the brick partition in regenerative furnaces, etc.

Generator.—1. An apparatus in which a fluid or gas is generated from solid or liquid materials.

2. A steam boiler, more especially a tubular one, or an automobile boiler.

3. An apparatus whereby acetylene is formed from calcium carbide and water, for use on an automobile, etc.

4. In refrigeration, by the ammonia absorption process, a closed vessel in which aqua ammonia or ammoniacal liquor, of a density of 28° Beaumé, is heated by a steam coil, thus generating ammonia gas under pressure.

Geography.—The science of the description of the earth's surface as it exists at present, and the distribution on it of its products and animals, particularly mankind.

Geometric.—According to the rules or principles of geometry.

Geometrical Axioms.—1. Things which are equal to the same thing are equal to each other.

2. When equals are added to equals the wholes are equal.

3. When equals are taken from equals the remainders are equal.

4. When equals are added to unequals the wholes are unequal.

5. When equals are taken from unequals the remainders are unequal.

6. Things which are double of the same thing, or equal things, are equal to each other.

7. Things which are halves of the same thing, or of equal things, are equal to each other.

8. The whole is greater than any of its parts.

9. Every whole is equal to all its parts taken together.

10. Things which coincide, or fill the same space, are identical, or mutually equal in all their parts.

11. All right angles are equal to one another.

12. A straight line is the shortest distance between two points.

13. Two straight lines cannot enclose a space.

Geometrical Drawing.—The art of representing to the eye the problems "worked out" by geometricians.

Geometrical Magnitudes.—Lines, surfaces, angles and solids constitute the different kinds of quantities called *geometrical magnitudes*.

1. A *line* is that which has extension in length only. The extremities of lines are points.
2. A *surface* is that which has extension in length and breadth only.
3. A *solid* is that which has extension in length, breadth and thickness.
4. An *angle* is the difference in the direction of two lines diverging from the same point.

Geometrical Progression.—In a progressive increase or decrease, in each successive number of a series, by the same multiplier or divisor at each step; as, 3, 9, 27, 81, 243, or 64, 32, 16, 8, 4, 2. With *arithmetical* progression, the increase or decrease is by addition or subtraction of the same figure at each step; as, 3, 6, 9, 12, 15, or 16, 14, 12, 10, 8.

Geometrical Signs.—The common algebraic signs are used in geometry, and it is necessary that the student in geometry should understand some of the more simple operations of algebra. As the terms circle, angle, triangle, hypothesis, axiom, theorem, corollary and definition are constantly occurring in a course of geometry, they are abbreviated as shown in the following list:

Addition	is expressed by	.....	+
Subtraction	"	.....	-
Multiplication	"	.....	×
Equality	"	.....	=
Greater than,	is expressed by	.....	>
Less than,	"	.....	<
Thus <i>B</i> is greater than <i>A</i> , is written	.....	<i>B</i>	> <i>A</i>
<i>B</i> is less than <i>A</i>, " " " "	.....	<i>B</i>	< <i>A</i>
A circle is expressed by	.....	O	
An angle	"	.....	∠
A right angle is expressed by	.....	R. L	
Degrees, minutes and seconds are	.....	° ' "
expressed by	.....	° ' "
A triangle is expressed by	.....	Δ	
The term Hypothesis is expressed by	.....	(Hy.)	
" Axiom	"	(Ax.)	
" Theorem	"	(Th.)	
" Corollary	"	(Cor.)	
" Definition	"	(Def.)	
" Perpendicular is expressed by	.....	⊥

Geometric Square.—An instrument (also known as *quadrat*), for measuring angles and altitudes, furnished with sights, a plummet and an index.

Geometry.—The science of measurement; mensuration belongs properly under this division of mathematics. Geometry is the root from which all regular mathematical calculations issue. The elementary conceptions of geometry are few: (1) a point; (2) a line; (3) a surface; (4) a solid; (5) an angle.

Geordie.—The original safety lamp used in mines, invented by George Stephenson, having a cylindrical cover of sheet metal, perforated with small holes, to

prevent firedamp from communicating with the flame; later improved by Sir Humphrey Davy.

Germanium.—A metal of gray-white color and fine metallic luster. It melts at 1562° F.

German Silver.—An alloy of nickel, copper or zinc; sometimes called nickel silver.

Getting.—In mining, the act or process of cutting coal and bringing it to the surface.

Geyser.—1. An intermittent hot spring, throwing up water in fountain-like columns.

2. An apparatus used for the rapid heating of water connected with baths.

Giant Powder.—Dynamite; nitroglycerine combined with some absorbent material; as, fossil meal.

Gib.—A piece or slip of metal or wood, notched or otherwise, in a machine or structure to hold other parts in place, or bind them together, or to afford a bearing place; usually held or adjusted by means of a wedge, key or screw.

Gib and Key.—In a steam engine, the fixed wedge or gib, and the driving wedge, key or cotter used for tightening the strap which holds the brasses at the end of a connecting rod. Called also gib and cotter.

Gibbet.—The projecting arm of a crane, fitted with a pulley for raising weights; a jib.

Gib Headed Key.—In machinery, a key having an offset standing at right angles with the thicker end, for convenience of drawing it back in situations where the use of a drift is not practicable. *This device has been the cause of accidents.*

Gig.—1. A light ship's boat.

2. A rotary cylinder covered with wire, used in cloth making.

Gig Mill.—A machine in which woolen cloth is teased by means of a gig, or cylinder covered with wire teeth, for raising a nap on the cloth.

Gilder's Wax.—A fatty, solid substance which is used by gilders to cover those parts of an object which are not intended to be gilded.

Gilding.—1. The art of overlaying or covering with gold leaf; also, a thin coating or *wash* of gold, or of that which resembles gold.

2. Gold in leaf, powder, or liquid for application to any surface.

Gilding Tool.—A burnisher used in fixing gold leaf in the lettering and ornamental work on book covers.

Gilding Wax.—A composition made of beeswax, borax, and red ochre, used by gilders to improve the color of gilding.

Gill.—1. In manufacture, one of the combs of closely ranged steel pins which divide the ribbons of flax fiber or wool into fewer parallel filaments.

2. In construction work, a timber vehicle consisting of a pair of wheels and a frame.

3. A measure, a fourth of a pint.

Gilling Machine.—In worsted manufacture, a machine in which the wool is drawn between series of rollers, and over the projecting teeth of heavy steel bars termed *fallers*. The gilling machines are arranged in series so that the teeth of each set of fallers is finer and closer pitched than the preceding.

Gimbals.—Two rings forming a universal joint, on which are mounted the compass cards, lamps, or navigational instruments which are desired to be in a constant position irrespective of the motion of the vessel.

Gimble Joint.—In line shafting, the ends of the shafts to be connected are prolonged into *forks* which swivel on the ends of a cross, each arm of which also swivels in an arm of the forks. Used for carrying shafting around angles of buildings.

Gimlet.—A small, screw pointed tool used for boring holes in wood.

Gimlet Bit.—A small boring tool, distinguished from the gimlet in that it is a bit with square shanks to put into the brace.

Gimp Nail.—In pattern making, a small round headed upholsterer's nail used by pattern makers for fastening pattern letters to *name plates*.

Gin.—1. [A contraction of *engine*.] A machine or instrument by which the mechanical powers are employed in aid

of human strength; especially, a machine consisting of a tripod formed of poles united at the top, one of them being longer than the rest, and called the *pry pole*, with a windlass, pulleys, ropes, &c., for raising or moving heavy weights, lifting ores from mines, and like purposes.

2. In mining, a hoisting drum; a whim.

3. A pump moved by rotary sails.

Gin Horse.—A machine for raising or moving heavy weights, consisting of a tripod formed of poles united at the top, with a windlass, pulleys, ropes, etc.; a *gin*.

Ginning Cotton.—To clear of seeds by a machine called a *gin*.

Gin Pole.—[From *gin*, a contraction of *engine*.] A contrivance for raising or moving heavy weights, consisting of a strong pole with four ropes fastened at the top end to guide it, and also a block and fall fastened on the top of the pole. Generally a small cross piece about 8 or 10 inches down from the top, is nailed on, to hold guide lines and hoisting tackle.

Gipsy Wheel.—A wheel or pulley, grooved and channeled on its circumference to fit the links of a chain; used to transmit power.

Girder.—1. In architecture, a principal beam, spanning from wall to wall of a building, affording support for the binding joists, to which floor and ceiling joists are connected.

2. In engineering, a beam of iron or steel, either cast or rolled as one piece, or else built up out of plates and sections of mild steel. The latter method is the more usual and is what is generally understood by the term.

3. In carpentry, a fitch beam, or one of several planks secured together, side by side.

Girder Frame.—A type of engine framing in which the main portion from the cylinder to the crank shaft bearings is formed as a girder; this pattern is general with horizontal Corliss engines.

Girder Rail.—In street railways, a deep sectioned rail with wide surface bearing used on surface roads, so that the rail may be imbedded in the paving of the streets.

Girder Sections.—Rolled joists and girders of H or I form or similar sections, for use as girders.

Girder Stays.—In boiler setting, the stays of girder form supporting the crown of a combustion chamber.

Girth.—The circumference of anything. The girth of a rope and its circumference are the same.

Girth Seams.—The seams which pass around the body of the boiler, commonly known as circumferential seams.

Git.—In moulding, the body of waste metal attached to the casting, which fills the gate in the mould.

Gland.—The sliding bushing which holds the packing in a stuffing box; it is adjusted by bolts and nuts. Sometimes called a *follower*.

Glass.—A hard, brittle, usually transparent substance made by melting together sand or silica with lime, potash, soda or lead oxide. Different qualities of glass such as flint, crown, plate or bottle are made by varying the proportions.

Glass Cutter.—One who shapes the surface of glass by grinding and polishing, or one who cuts sheets of glass into sizes.

Glass Gauge.—An instrument used in addition to try cocks to indicate the height of the water line in a steam boiler; a vertical glass tube, placed at the front end of the boiler and in which the water rises and falls as within the boiler shell itself.

Glass Metal.—The fused material for making glass.

Glass Paper.—A kind of sandpaper in which pulverized glass is used instead of quartz.

Glass Papering Machine.—In wood-working, a machine for smoothing the surfaces of woodwork; a cylinder or disc covered with fine *ground glass* brought to bear upon the surface of the woodwork.

Glass Pot.—The pot, made of the most refractory fire clay, in which the material used in the manufacture of glass is melted; for some qualities of glass they are covered, having an opening in the side, while for other grades, they are open, with sloping sides.

Glass Silk.—Fine threads of glass wound when in fusion upon revolving heated cylinders.

Glass Silvering.—The process of transforming plate glass into mirrors by coating it with a reflecting surface; as, a deposit of silver or a mercury amalgam.

Glaze.—1. A substance, which when applied to the surface of metals, pottery, etc., and exposed to the action of heat, melts and gives them a lustrous surface.

2. In oil painting, a thin layer of transparent color laid over another to modify its tone.

Glazed Brick.—A brick coated with a transparent glaze.

Globe.—A sphere or ball; a solid whereof the diameter through the center is everywhere the same; anything which is nearly spherical or globular in shape.

Globe Head.—A special ball shaped head given to rivets used to unite sheet metal articles.

Globe Joint.—A species of universal joint in which the usual cross is replaced by a globe or ball and socket.

Globe Valve.—A valve having a round ball like shell; it is much in use for regulating and controlling the supply of steam, air, etc., to the various auxiliary appliances in connection with steam power.

Globule.—A little globe; a small particle of matter of spherical form.

Glory Hole.—A opening in the wall of a glass furnace, exhibiting the intense white heat of the interior; by extension, an opening through the brickwork of any furnace.

Gloss.—Brightness or luster of a body proceeding from a smooth surface; polish; as, the gloss of silk; cloth is calendered to give it a gloss.

Glossary.—A dictionary of selected special terms relating to a particular art or science; in general, any vocabulary of unusual words and phrases.

Glost Firing.—In pottery, the remelting of the glaze; the second firing of the piece to fuse the glaze into which it has been dipped.

Glow.—White or red heat; to give forth vivid light and heat.

Glucinum.—A rare metallic element of a white color, resembling magnesium in its properties.

Glucose.—A sugar made principally from corn. It is made commercially by treating starch with diluted sulphuric acid, and the resulting solid product is called *grape sugar*, and the *syrup, glucose*.

Glue.—A viscous liquid, having strong adhesive qualities, used to cement together pieces of wood, leather, pasteboard, broken china, glassware, etc. The ordinary commercial glue is obtained by boiling the cuttings from hides, hoofs, etc. Another quality is made from the air bladders of fishes; called fish glue or isinglass.

Glue Tester.—In glue manufacture, a species of meter, employed to ascertain the strength of the various liquors obtained from boiling skins, hoofs, etc. It contains its own thermometer.

Glutting.—In steam engineering, the choking of condenser tubes. Animal oils, including tallow, suet and lard, are found to produce both glutting and corrosion, the decomposition of the fats causing formation of fatty acids, and the deposition of carbon.

Glut Weld.—A type of weld employed considerably in repair work, where it is necessary to maintain unchanged the length of the broken part. The ends of the two parts are tapered down, and the angles filled with wedges of iron, the whole being welded together while checking the length with a trammel, superfluous material being subsequently cut away.

Glycerin or Glycerine.—An oily colorless and odorless liquid, with sweetish taste, obtained from fats by the action of superheated steam.

G. M. B.—An abbreviation for the English term: Good merchantable brands. The fair average quality of copper ingots as quoted in the metal market, etc.

Gnarl.—A knot in wood; knotty; full of knots.

Gneiss.—A crystalline or igneous rock, consisting, like granite, of quartz, feldspar and mica, but having these materials, especially the mica, arranged in planes, so that it breaks rather easily into coarse slabs or flags.

Go.—To pass from one place to another; to be in motion; to be in a state not motionless or at rest; to proceed; to advance; to make progress.

Go About.—To put the ship around, or on another tack; going with her head towards the wind; the reverse of wearing.

Goaf.—In coal mining, the worked out portion of a mine, more or less filled with rubbish. Plural, goaves.

Go Ahead.—1. To progress in a forward direction.

2. The gear which causes the engine to drive the ship forward.

Go Astern.—To proceed astern, or backwards; the reverse of go ahead.

Gob.—In coal mining, the rubbish used to pack the goaves; the same as attle or deads, with metal miners.

Gobelin.—1. A superior kind of French tapestry, deriving its name from the brothers Gobelin.

2. A variety of damask used for upholstery, made of silk and wool, or silk and cotton.

Go Devil.—1. The squib or detonator which is dropped down a drilled well to explode the nitroglycerin used to "shoot" it.

2. A scraper with self adjusting spring blades, inserted in a pipe line, and carried forward by the fluid pressure, clearing away accumulations of paraffin, etc., in the walls of the pipe.

Gold.—As a medium of exchange, the most useful of the precious metals, noted for its beautiful yellow color, ductility, malleability, and freedom from liability to rust or tarnish. Its specific gravity is 19.3 and melting point 2000° F. It is used largely by all modern civilized nations as a monetary standard, and in most of them is the only legal tender.

Gold Beater's Skin.—The outside membrane of the large intestine of the ox, which has great tenacity. It is cut in sheets and placed between the layers of gold while they are under the hammer. This membrane is also used to some extent in making small balloons.

Gold Beating.—The process of hammering gold into very thin sheets. The leaves of gold are placed between sheets of membrane, called gold beater's skin; which see.

Gold Leaf.—Gold hammered in a very thin sheet, 3½ inches square. It is used for gilding and ornamenting, also in dental practice. A book of gold leaf contains 25 sheets.

Gold Mill.—A mill where gold quartz is ground into minute particles.

Gondola Car.—A railway freight car having low sides, and no roof.

Gong.—1. A variety of bell, circular and flat in shape, beaten with a wooden mallet to emit a sonorous note.

2. A flattened circular bell, struck by a mechanical hammer in signalling apparatus.

Goniometer.—An instrument for measuring angles; as, the angles between the faces of crystals.

Gooch Link.—A double eccentric reversing gear in which the link is curved opposite to the Stephenson link.

Gooch Link Motion.—A system of reversing and expansion gear in which the link is stationary with its sweep away from the crank shaft, being suspended at center from a swinging arm, depending from a convenient bracket. A radius rod or connecting rod, attaches the valve spindle to the link block, and it is this radius rod which is shifted by the reverse lever. When the block is in line with the eccentric rod at either end of the link, the motion is in full gear forward or backward, as the case may be, as it approaches the center, expansion is increased, without variation of the lead, and finally in the center position, the travel of the valve becomes twice lap + lead, and consequently steam is shut off.

Goods Trains.—On English railways, trains conveying general merchandise or freight only, as distinguished from those carrying coal or other minerals, or special commodities, such as milk, fish or market produce, or those running empty.

Goodwill.—A business term. The value that a business has over and above the stock in trade and the money invested in it; often figuring as one of the assets of a business, and sometimes the principal asset; as, the good reputation of an article of manufacture.

Goodyear, Charles.—Born 1800, died 1860. He received a Public School education, and after coming of age, he joined his father in the manufacturing of hardware. Later he devoted himself to the improvement of the manufacture of india rubber. In 1839, he discovered that a piece of india rubber mixed with certain ingredients, when brought in contact with a red-hot stove was not melted, but that in portions was charred, and in other portions remained elastic, though deprived of adhesiveness; *i. e.*, the material was vulcanized. From this time until his death, the process of vulcanization occupied his attention.

Gooseneck.—1. In steam fitting, the curved pipe leading from a still to the worm.

2. The swiveling joint on which a boom is connected to a mast.

3. In a locomotive tender, a cast iron or brass pipe, bent to give the connection between the water valve and the hose for the feed supply.

4. In a foundry, the bent rod used to open and close the tap hole in a cupola.

5. In structural iron work, a bent iron strap, used to hold down a ratchet in drilling.

Gopher Holes.—In mining, operating in a haphazard manner and on a small scale, without regard to future developments; such mines being known as gopher or coyote holes.

Gore.—A triangular piece fitted into anything, similar to a gusset; as, in the narrow parts of a sail, or in fitting a strake of planking to the frames.

Gore Strake.—A strake of plating that terminates before reaching the stern post.

Gorge.—A narrow passage between hills; ravine.

Gothic Letters.—Full face black letters such as are used for **LETTERING DRAWINGS**.

Gouge.—A chisel, with a hollow or semi cylindrical blade for scooping or cutting holes, channels, or grooves, in wood or stone; a similar instrument, with curved edge, for turning wood.

Gouge Bit.—A bit, shaped like a gouge, for boring wood.

Govern.—To direct and control; as, the actions of men, either by established laws or by arbitrary will; to regulate with authority; to keep within the limits prescribed by law.

Government.—The body politic governed by one authority; a commonwealth; a state.

Governor.—1. A device or attachment for controlling and regulating the speed of a prime mover, usually by means of centrifugal force or by pressure. In a steam engine, the principle of the conical pendulum is generally employed, as the speed of the engine increases, the centrifugal force causes the weights to fly out, thus shortening the height of the pendulum; this shortening pull being transmitted to the throttle valve or valve gearing of the engine. A governor of the same type controls the admission of water to water-wheels, turbines, etc.

2. In gas making, a central regulating apparatus which maintains a steady pressure in the mains of a certain district, regardless of fluctuations of manufacture or intermittent consumption. The governor usually works as a float valve, or the pressure maintained by a bell upon the gas.

Grab.—A bucket opening on a hinge, the meeting edges of which are provided with teeth or a sharp edge. Much used for dredging or working ores or similar cargoes.

Grabber.—A tool or implement for grabbing or digging.

Grab. Irons.—A name applied to the hand holds or hand rails on a locomotive tender, for trainmen to grasp when mounting the steps.

Grade.—1. In a railroad or highway, the rate of ascent or descent; usually stated as so many feet per mile, or as one foot rise or fall in so many of horizontal distance; as, a heavy grade; a grade of twenty feet per mile; or of 1 in 254; deviation from a level surface to an inclined plane.

2. A graded ascending or descending portion of a road.

Grade Crossing.—Where a road or another railroad crosses a railway line on the same level; also known as level crossing.

Gradient.—Rising or descending by regular degrees of inclination; as, the gradient line of a railroad.

Grading Chest.—In milling, a grader or separator in which the grain is graded or sorted before passing to the *first break rolls*.

Gradometer.—A variety of clinometer, consisting of a curved glass vial filled with alcohol and a graduated scale. The position of the bubble shows the degree of the gradient.

Gradual.—Proceeding by steps or degrees; advancing, step by step, in ascent or descent; progressive; slow; as, a graduated decline.

Graduation.—The process of dividing into necessary spaces or degrees; the scales of mathematical, astronomical, and other scientific instruments.

Grain.—1. The composite particles of any substance.

2. The smallest unit of weight, which had its origin in the weight of a plump grain of wheat. In the pound of the apothecaries' weight, or Troy pound there are 5760 grains; in the avoirdupois pound there are 7000 grains.

3. A very small portion of anything; as, a grain of dust.

4. The texture of a substance; as, wood or stone of fine grain.

5. The seed of leather from which the hair has been removed, showing the fibrous texture.

6. To grain (verb); as, to paint in imitation of wood or stone.

Grain Elevator.—A large building having machinery and appliances for unloading cars of grain and placing it in bins for storage purposes. Spouts are attached to the lower level of these bins so that the grain may again be reloaded into other cars for shipment, and still larger spouts or marine legs provide for very rapid loading of vessels.

Gram, or Gramme.—In the metric system of weights and measures, the unit of mass, being the thousandth part of a kilogram; it is equal to 15.432+ or nearly 15½ Troy grains.

Grammar.—1. The science of language; the theory of human speech; the study of forms of speech, and their relations to one another.

2. The art of speaking or writing with propriety and correctness.

Granite.—A crystalline, unstratified rock, consisting of quartz, feldspar and mica, and presenting usually a whitish, grayish, or flesh red color. It differs from gneiss in not having the mica in planes. Granite is regarded as a true igneous or fire rock.

Granulate.—To collect or be formed into grains; as, cane juice granulates into sugar.

Granulated Cork.—Shavings and chips produced in cork manufacture, ground up with the commoner descriptions of cork. Used as an insulating material in the construction of refrigerators, and applied with paint to iron surfaces on shipboard, etc., to prevent "sweating."

Grape Sugar.—A sugar extracted from grapes and other sweet fruits, less sweet than cane sugar; produced artificially from starch, dextrin and cellulose, by the action of acids, ferments and reagents. Also known as *glucose*.

Graphic.—1. Representing with clearness; describing vividly.

2. Relating to the use of linear figures, diagrams and curves in the solution of problems.

Graphic Arts.—Those in which ideas are expressed by lines, such as engraving, etching, painting or drawing.

Graphic Calculation.—A branch in algebra in which the properties of equations are treated by the use of *curves and straight lines*.

Graphic Method.—The system or method of solving problems in the equalization or distribution of forces, stresses, loads, etc., by means of accurately drawn figures and diagrams.

Graphite.—One of the forms in which carbon occurs in nature; also known as black lead and plumbago. It has an iron-gray color and metallic luster. It is soft and unctuous to the touch and is used chiefly in the manufacture of pencils and crucibles, and as a lubricant with machinery.

Graphophone.—An instrument used for the recording and reproduction of sounds, similar to the phonograph, but somewhat different in mechanical construction.

Grapnel.—A hook with many flukes, used as an anchor for small boats, to grapple or hold fast vessels together in action or otherwise, to raise ropes or telegraphic cables from the sea bottom; a hooked anchor with five or six curved flukes, used as a kedge for warping, or as an anchor for boats and small craft.

Grapple.—To seize; to lay fast hold on, either with the hands or with hooks.

Grappling Iron.—1. A grapnel; a hook used to secure one vessel to another to exchange cargo.

2. A grasping tongs made in a variety of forms and sizes.

3. A hooked implement resembling a grapnel used to recover submarine telegraph cables for purposes of repairing, etc.

Grate.—That part of the furnace which is composed of alternate bars and spaces to support the fire and admit the air.

Grate Area.—The surface in square feet of the fire grate in a boiler or boilers.

Grate Bars.—These consist of a number of cast iron bars supported on iron bearers placed at and across the front and back of the furnace of boilers.

Grate Center Frame.—In rocking or shaking grates, a longitudinal cast iron bar in the center of the firebox, which serves to support the grate bars under a steam boiler.

Grate Side Frame.—Bearer bars arranged alongside the firebox walls,

serving to support and serve as a fulcrum for a shaking grate.

Grate Surface.—The total square feet in the grate bars, as they are arranged in the furnace for firing upon.

Grating.—A perforated cover to close an opening, as into a cellar or basement; a grille of bars acting as a screen or riddle.

Gravel.—Small stones, or fragments of stone; very small pebbles; often intermixed with particles of sand.

Gravel Dash.—In building, the coating of external walls with a mixture of mortar, sand and gravel. Most generally known as *rough-cast*.

Gravel Pit.—A pit from which gravel is dug.

Graver.—1. One who carves or engraves; one whose occupation is to cut letters or figures in stone, or other hard material.

2. An engraving tool; an instrument for graving on hard substances. A tool for turning metals, resembling an engraving tool.

Graving Dock.—A dry dock for the repair or inspection of ships.

Gravitation.—That species of attraction or force by which all bodies or particles of matter in the universe tend towards each other; in a more limited sense, gravity is the tendency of a mass of matter toward a center of attraction, especially the tendency of a body toward the center of the earth. Called also *attraction of gravitation*, *universal gravitation*, *universal gravity*.

Gravity.—Something which gives to every particle of matter a tendency toward every other particle. This influence is conveyed from one body to another without any perceptible interval of time. The weight of the body is the force it exerts in consequence of its gravity, and is measured by its mechanical effects. We weigh a body by ascertaining the force required to hold it back, or to keep it from descending. Hence, weights are nothing more than measures of the force of gravity in different bodies.

Gravity Wheel.—In hydraulics, a water wheel in which the weight of the water alone is utilized, the water resting in the buckets until discharged. *Overshot wheels* are gravity wheels.

Gray Iron.—There are many varieties of cast iron, differing from each other by almost insensible shades. The two principal divisions are gray and white, so called

from the color of the fracture when recent. Gray iron is softer and less brittle than white iron. It is to a slight degree malleable and flexible, can be easily drilled and turned in the lathe, and does not resist the file. It has a brilliant fracture, of a gray, or sometimes a bluish gray color; the color is lighter as the grain becomes closer, and its hardness increases at the same time.

Gray Stone.—A grayish or greenish compact rock, composed of feldspar and augite and allied to basalt.

Graze.—A light touch; a slight scratch.

Grease.—Animal fat, as tallow and lard, especially when in a soft state; oily matter of any kind.

Grease Cup.—A cup for the reception of grease, placed on the top of or near a bearing so that it may supply the latter with lubricant.

Grease Extractor.—A chest fitted with numerous perforated diaphragms, which riddle the grease out of the feed water on its passage through.

Greaser.—One who, or that which greases; as, a person employed to lubricate the working parts of machinery, engines, etc.; an oiler.

Greasy Steam.—In steam engineering, steam which becomes its own lubricant by a mechanical admixture of grease therewith. The grease is mingled with the steam before its entry into the cylinder.

Great Circle Sailing.—In navigation, the art of conducting a ship on a great circle of the globe, or on the *shortest arc* between two places; as, between San Francisco and Yokohama.

Greathead, James Henry.—Born 1844, died 1896. An English engineer. His first prominent work was the construction of the Tower subway, of cast iron, under the Thames in 1869. In 1886 he commenced the tunnels for the City and South London Railway, in which compressed air was, for the first time, used in connection with a shield in water bearing strata. He was the pioneer of all modern tunnel work, involving the use of a shield, though Brunel, as far back as 1818, had secured a patent which established the principles along which modern tunnel practice has developed.

Greathead Shield.—A tunneling machine, extensively used in boring through soft or waterbearing ground. A large ring, whose interior diameter is the same as that of the lining of the tunnel, is advanced by means of hydraulic rams disposed around the circumference, the ring having a

cutting edge. In firm ground, excavators work ahead of the shield and throw the spoil through hatches in its flat face, but in waterlogged strata, an airlock is erected behind the shield, and work is continued under compressed air, the excavators staying behind the shield and removing the material through the hatches, which are provided with self closing doors. As the shield is advanced, the tunnel lining of cast iron segments is fitted in behind it, the rams using the last laid segmental ring for a fulcrum. Working, being carried on from each end, when the tunnel is bored through, the two shields are left in the middle, with their central diaphragm or bulkhead removed, and serve as lining for that portion of the bore.

Greek Alphabet.—The letters of the Greek alphabet are used as arbitrary signs, and the letter π (pi) is used almost universally to represent the ratio of the circumference to the diameter of the circle.

A	α	alpha	I	ι	iota	P	ρ	rho
B	β	beta	K	κ	kappa	Σ	σ	sigma
Γ	γ	gamma	Λ	λ	lambda	T	τ	tau
Δ	δ	delta	M	μ	mu	Υ	υ	upsilon
E	ϵ	epsilon	N	ν	nu	Φ	ϕ	phi
Z	ζ	zeta	Ξ	ξ	xi	X	χ	chi
H	η	eta	O	\omicron	omicron	Ψ	ψ	psi
Θ	θ	theta	Π	π	pi	Ω	ω	omega

Green Coal.—In blacksmithing, the small coal newly laid in a fire.

Green Sand.—A sand containing a large proportion of grains of glauconite (a silicate of iron and potassium) which gives it a greenish hue. It is used for moulding purposes in foundries, and extensive deposits in New Jersey are utilized under the name of *marl* for fertilizing purposes.

Gregorian Calendar.—The calendar as reformed by Pope Gregory XIII in 1582, including the method of adjusting the leap years, so as to harmonize the civil year with the solar. Thus, every year of the current reckoning, which is divisible by 4, except those divisible by 100, (and not by 400) has 366 days; all other years have 365 days.

Grid.—1. A grating for a vault or sewer, or any grating of bars.

2. A heavy framing of timbers used to support a ship in a dock.

Griddle.—In mining, a sieve with a wire bottom.

Gridiron.—A framework of heavy balks of wood on the shore, between high and low water mark, on which small craft may be repaired between tides.

Gridiron Pendulum.—A compensation pendulum. The bob is supported by parallel bars of two metals which are unequally expanded by heat. Those are so disposed that, while one tends to lengthen it, the other tends to shorten it; the ratio of lengths is determined by the relative expansibility.

Gridiron Valve.—A type of slide valve, familiarly called a "grid," which may be circular or rectangular, consisting of alternate bars and spaces, sliding over a similarly formed seat, the object being to obtain the necessary steam way with a diminished amount of valve travel.

Grids.—1. Gratings of thin parallel bars similar to gridirons.

2. Wire bottomed mining sieves.

3. Cribwork on which vessels are hauled out of water for examining, cleaning and repairing their hulls.

Griffe.—In weaving, that part of an attachment by means of which the leashes are lifted through their hooks, which are suspended from projections upon the griffe.

Grill.—A grated utensil for broiling meat; a gridiron.

Grille.—A grating; an arrangement of parallel or cross bars, or structure of open wood or metal work, used to close an opening, or to separate one part of a room from another.

Grill Work.—In engineering, a heavy frame work of cross timbering, resting upon the heads of piles, serving as a foundation for a building resting on insecure or treacherous soil.

Grime.—Foul matter; soot; dirt rubbed in.

Grind.—To wear down, polish, or sharpen by friction; to make smooth, sharp, or pointed.

Grinder.—1. A machine tool in which machinery parts are shaped to exact size, by means of rotating discs of emery or other abrasive material. A shaft or similar piece is mounted between centers, as in a lathe, and rotated, while rapidly rotating wheels travel up and down its length upon what corresponds to the slide rest; by this means accuracy of finish is obtained. Other types of machines are constructed, dealing with flat surfaces.

2. An emery wheel for grinding tools.

3. A workman employed in the manufacture of cutlery, edge tools, etc., who sharpens the instruments or polishes them upon a grindstone.

Grinding.—1. The process of disintegrating a material and reducing it into small particles or dust by crushing or attrition.

2. The removal of material from a surface by some abrasive agent, such as an emery wheel, or grindstone.

3. Roughening glass by means of rubbing it with fine sand or emery; this results in obscuring the surface, making a semi transparent screen. Such articles as gas globes, which have a clear pattern on an obscure ground, are made by pasting a paper pattern on the glass, the remaining surface being obscured by means of a sand blast, the paper serving as protection.

Grinding In.—In machine work, the bringing of the conical bearing surfaces of plugs and cocks of a circular shape to an exact fit, by means of emery powder. The powder is strewn over the surface along with a little oil, and is made to abrade them by turning the plug through portions of a revolution, each two or three successive turns commencing at different starting points in the circle, in order to make the wear more equable.

Grindstone.—A flat, circular stone, revolving on an axle for sharpening tools or shaping or smoothing objects.

Grindstone Truer.—In shops, grindstones are trued by means of a threaded roller of steel, clamped in a frame and allowed to rotate against the surface of the stone.

Grip Controller.—A device applied to motor cycles operated from the grip, or handle, which controls the motor by checking the exhaust or interrupting the electric communication.

Gripe.—1. To clutch; to hold fast; to clasp closely with the fingers.

2. The forefoot of a vessel to which the stem is fastened.

Grist.—That which is ground at one time; as much grain as is carried to the mill at one time; or the meal it produces.

Grist Mill.—A steam or water mill for grinding grain, especially a mill for grinding grists, or portions of grain brought by different customers; a custom mill.

Grit.—1. Sand or gravel; rough hard particles.

2. To grate, to grind, to give forth a grating sound; as, sand under the feet.

Gritstone.—Any flinty rock whose particles have sharp edges so that it can be used for grinding. The Berea, Ohio, sandstone is the best known gritstone in the United States.

Groin.—In architecture, the angular curve made by the intersection of two semi cylinders or arches.

Grommet or Grummet.—In engineering, a ring formed of a strand of rope, laid round by others in a particular manner; a ring of a soft yarn strand wound around or served by its own part, used to stop leaks under bolt heads.

Groove.—1. A semicircular furrow cut in anything, as by a *gouge*.

2. A rut, a furrow.

3. To deteriorate through the formation of furrows or striations. This defect is noticeable in locomotive boilers, occurring near the radii of the internal firebox sideplates; the grooves running horizontally; they are probably caused by working or parting of the plate, similar to the cracks on a piece of sheet brass, bent backwards and forwards in the hands.

Grooved Friction Wheels.—A wheel, the motion of which is caused by frictional contact, in which perimeters are *grooved* to have a greater contact, as the surface engaged is increased, and the elastic material of the respective faces, caused to bind; as, in rope transmission by means of *grooved* pulleys.

Grooving.—This may be described in steam boilers as surface cracking of iron, caused by its expansion and contraction, under the influence of differing temperatures. It is attributable generally to the too great rigidity of the parts of the boiler affected.

Grooving Saw.—A small circular saw about five or six inches in diameter and of varying thickness, by means of which grooving and gulleting may be done for cabinet, pattern and picture frame makers.

Gross.—1. Coarse, especially in form or texture; not delicate.

2. Big, bulky, larger than ordinary.

3. In amount or quantity undiminished by any deduction whatever; as, *gross* revenue, i. e., without deduction of operating expenses, interest, depreciation, etc.; *gross* liabilities, or those reckoned without allowing for counter-vailing items.

4. Large quantities or by wholesale; in this sense, the term *grocer* originated from *grossier*, a wholesale merchant.

5. A dozen dozen; one hundred and forty four.

Gross Register.—In marine service, the total capacity of a ship without deductions for machinery or accommodation.

Gross Ton.—2240 pounds; a metric ton is 1,000 kilograms or 2204.6 pounds.

Ground In.—In calico printing, by means of hand blocks, to print further colors on a fabric, which has already been once printed.

Grounding.—The act of a ship's taking the ground or going ashore.

Ground Line.—The ordinary level of the surface of the ground, above or below which the height of structures or the depth of excavations are measured.

Ground Plane.—In drawing perspective, the plane upon which the observer is supposed to stand.

Ground Tackle.—Anchors, cables, etc., which are used to secure a ship to the bottom.

Ground Work.—The foundation work of a structure; the preparation of the ground to receive work; that which furnishes a foundation or support of anything.

Grouting.—In construction work, the pouring of a mixture of cement, sand and water into the *voids* of stone, brick or concrete work, either to give a solid bearing or to fasten anchor bolts, dowels, etc.

Groynes.—Structures erected along a shore to check the movement of the shore drift and thereby protect the coast from denudation.

Grozing Iron.—A plumber's tool for finishing soldered joints.

Grub Screw.—A screw which has neither nut nor head of any kind, but which is simply *slotted* across the top end for the insertion of a screw driver, by means of which it is driven home.

Grummet Washer.—In structural iron work, a washer made of a strand of rope, yarn, or tar twine, twisted into the form of a ring. It is employed for insertion under the heads of square shouldered bolts, in built up cast iron water tanks, etc.; its purpose being to prevent leakage around the heads where the rust caking does not completely fill.

Grunter.—In founding, a rod with a hooked end used to assist in supporting a crucible.

Guarantee.—To assure or secure against loss or damage, also guaranty, as to warrant or guaranty the fulfillment of a contract.

Guard.—1. Any one of various protecting or defensive devices, for wearing or for attaching to an object; as, a machine or implement; as, a frame to prevent a nut from unscrewing.

2. The English equivalent for conductor, deriving his title from the guard of the old stage coaches; he is also baggage master and expressman, sometimes collects tickets, but never issues any or receives payment of fares.

Guard Plate.—A plate in front of an iron furnace, covering the hole through which the slag is drawn out, and having in it the tapping hole.

Guard Rail.—1. A beam or rail, parallel to and near a main rail in a track to keep the wheel flanges against the main rail; used at switches and curves over dangerous places. Called also *wing rail* and *safety rail*.

2. A hand rail around a hatchway or similar place.

Guards.—Extensions of a side wheel ship's decks, which strengthen and protect the paddle boxes. In some American river steamers these guards are made large enough to carry the boilers and thus keep the centre of the ship clear; *sponsons*.

Guard Strap.—In railway engineering, the strips of sheet iron which arch over the tops of the wheels of locomotives, as a protection against injury to and from the drivers.

Gudgeon.—1. In millwrighting, a metallic journal piece let into the end of a wooden shaft.

2. A metal pin for joining two pieces of stone.

3. The journal or bearing of a water wheel or turbine.

Gudgeon Pin.—In machinery, the pin fastened in the end of a wooden shaft or axle.

Guibal Fan.—A large type colliery ventilating fan, sometimes 48 feet in diameter, having eight *vanes*, revolving in a close fitting masonry shrouding; the foul air being taken in at one side, and expelled through a gradually enlarging chimney, whose entrance is controlled by a flexible wooden shutter sliding in guides curved to suit the fan.

Guide.—In a steam engine, an arrangement of bars, whereon the crosshead of a piston rod slides, keeping the latter in a straight path.

Guide Bar.—One of the flat or sectional bars which guides the piston rod crosshead of a locomotive or horizontal engine, taking the thrust of the connecting rod.

Guide Blades.—The stationary vanes or partitions within a turbine, which direct the fluid upon the revolving blades at a proper angle.

Guide Block.—A distance piece formed or fastened upon the back cylinder cover, to which the guide bars are attached, and which maintains them in their proper relative positions.

Guide Combs.—In vertical engines, are pieces of sheet metal of comb like form, which dip into oil troughs at the bottom of the guides, and carry a film of oil over their surface.

Guide Passages.—In hydraulics, passages which direct the water upon the blades of a turbine, the enclosing partitions being movable to vary the width of the flow, etc.

Guide Post.—The post on which a guide-board is erected; also the post and board taken together; sign post; finger-post.

Guide Pulley.—A loose pulley or idler used to guide a driving belt, or to prevent its coming in contact with a standing piece.

Guide Sheave.—A small grooved pulley like a block sheave, used in connection with belt conveyers, to keep the traveling belt in its correct position with regard to the rollers.

Guide Shoe.—An extension of the piston rod crosshead which engages with the guides. Also called *gib*.

Guides of a Cage.—In mining, the vertical beams between which the cage slides, maintaining it in a vertical direction.

Guide Yoke.—A stirrup or hanger which serves to attach the outer or rear end of the guide bars to the engine frame, and which keeps them in their proper relation to each other. In English practice, with inside cylinders, this guide yoke is known as *spectacle plate* or *motion plate*; with outside cylinders, it is usually termed *slide bar bracket*.

Guide Yoke Bracket.—A term applied to the extension of the guide yoke used

to support the guide bars at a point other than their end, which is often necessitated by the spacing of the wheels.

Guiding Link.—A detail of the valve motion of stern wheel engines, insuring the connection of the cut off reach rod with the forward rocker arm.

Guillotine Shears.—In machinery, a special type of shearing machine, used for the cutting up of puddled bars and slabs to make ready for piling. The shape of the device gives it the descriptive appellation.

Gulch.—A ravine, or part of the deep bed of a torrent when dry; a gully.

Gulf Stream.—A vast ocean current, flowing from the region of the Gulf of Mexico, northerly along the coast of the United States, and then northeastwardly in the direction of the British Islands and the Scandinavian Coast.

Gullet.—In mining and excavating, a preparatory cleft or opening in the strata.

Gullet Saw.—In saw milling, a saw whose teeth are deepened and hollowed in their roots. Circular and pit saws are usually gulletted, in order that the dust may run away freely, the gullets being sloped outwards on alternate sides.

Gum.—A viscid secretion, issuing from a variety of trees and shrubs. It hardens on drying, but becomes soluble in water, differing in this respect from resinous substances.

Gum Tragacanth.—A gum obtained from certain shrubs growing in the vicinity of Asia Minor. It is used as a stiffening in the printing of calicoes and similar textile fabrics.

Guncotton.—An explosive, made by steeping finely divided cotton fiber in strong nitric and sulphuric acid, afterwards washing with water to remove the excess acid. It burns gradually on ignition, and may smoulder away harmlessly when wet, but explodes violently under proper conditions.

Gun Metal.—A bronze, ordinarily composed of nine parts of copper and one of tin. The name is also given to certain strong mixtures of cast iron.

Gunpowder.—An explosive, compounded of 75 per cent. saltpetre, 15 per cent. charcoal, and 10 per cent. sulphur. The temperature of explosion is about 2000° C., and the volume of gas evolved is 300 times that of powder. When the ratio of volume of powder, to the capacity of the containing space is one, the pressure of explosion is about 42 tons per square inch.

Gunpowder Pile Driver.—A pile driver in which the pile is forced down by the explosion of gunpowder.

Gunsmith.—An artisan who has learned to make small arms; an occupation which has been almost entirely supplanted by the modern factory system, where all the various parts of a rifle or revolver are made by machinery and are interchangeable.

Gunter's Chain.—Consists of one hundred links, each link being seven inches and ninety two one hundredths in length; making up the total length of four rods, or sixty-six feet; hence, a measure of that length. An acre, contains ten square chains.

Gusset.—In machinery, a kind of bracket or angular piece of iron fastened in the angles of a structure to give strength or stiffness; especially the part joining the barrel and the firebox of a locomotive boiler; as, a gusset stay.

Gusset Plate.—An angular plate or bracket used to reinforce a boiler, tank, etc., where it changes from a circular to a square section; as, at the ends of shell boilers. The gusset plate acts as a bracket from the circular to the flat plates.

Gusset Stays.—Pieces of plate iron secured to the boiler front or back, near the top or bottom, by means of two pieces of angle iron, then carried to the shell plating, and again secured by other pieces of angle bar.

Gutenberg, Johannes.—Born 1400, died 1468. A German printer, famous as the inventor of printing from movable types (1438). At first he devoted his genius to devising various trifling inventions by which he was gradually led to his great achievement which consisted in the substitution of movable types for the engraved wood block page previously used. In 1450 he associated himself with Johannes Fust, a wealthy citizen of Mainz, who enabled him to set up a press, upon which was printed the famous 42 line Latin Bible. Though Gutenberg laid the foundation of one of the greatest arts, he died poor and almost friendless.

Gutta Percha.—The juice of a tree found in the Malay Peninsula and vicinity. It has many of the properties of india rubber (caoutchouc) and is used for various similar purposes, such as insulating electric wires, the manufacture of hose, belting, etc.

Gutter.—1. A trough for carrying rain water from the roofs of houses.

2. The depression made on the side of a road to carry off the surface water, or similar waterway.

Guttering.—1. The wood or metal material from which gutters or rain troughs are made.

2. The rapid and irregular melting of the tallow or wax of a candle, usually caused by a draft of air.

Guy.—1. A stay running from the head of a spar or upright piece to the platform whereon it is erected, or to the ground, so as to steady it.

2. A stay rod to connect the floor of a suspension bridge with the land on either side, in order to prevent awaying.

3. A rope stay to trim or steady any object, such as a flagstaff, chimney, gaff or boom, whether vertical, inclined or horizontal.

Guy Derrick.—In rigging, a mast, spar or tall frame, supported at the top by stays or guys, with suitable tackle for hoisting heavy loads.

Guys.—Ropes, rods or chains fitted to the mast of a derrick to hold it in a vertical position.

Gyle.—The fermented wort used in making ale, beer or vinegar; the *gyle tun* is the big vat in which it is contained.

Gypsum.—A common mineral, familiar in several forms; when ground to a powder it is called *plaster* and used as a fertilizer; when the water is driven off by heat it is called *plaster of paris* and is used for making moulds and cheap statuary; if of fine grain, it is used for ornamental purposes under the name of *alabaster*.

Gyration.—The act of turning or whirling around a fixed center; rotation.

Gyroscope.—An instrument used to illustrate the dynamics of rotating bodies, consisting essentially of a fly wheel, mounted in a ring, with its axis free to turn in any direction.



H.—An English letter, the eighth in the alphabet.

H.—An abbreviation for *hydrogen*.

h.—An abbreviation for (1) *hour*; (2) *hundred*.

Habeck.—An instrument with a hook at each end, for dressing cloth.

Hack.—1. A gash or dent made by a blow with a sharp instrument.
2. A pick axe; a mattock.

Hack Knife.—A stout knife set in a rigid leathern or wooden handle, used by glaziers, plumbers, etc.

Hackle.—In flax dressing, to separate; as, the coarse part of flax or hemp from the fine, by drawing it through the teeth of a hackle or hatchel.

Hack Saw.—A small frame or bow saw with a blade especially tempered for cutting metal. Used for shortening work too long to be cropped off by the hammer and chisel, or in cutting off finished work which it is desirable not to damage.

Hade.—In mining, an expression for the angle which a lode makes with a vertical line.

Hæmatite.—Native oxide of iron, so called from its blood red color. A valuable ore found in the Marquette region of Lake Superior, U. S. A., in Furness, England, and in the neighborhood of Bilbao, Spain.

Hair Compass.—A compass or divider capable of delicate adjustment by means of a screw; also hair divider.

Hair Felt.—A coarse fabric or stuff made of hair and wool, fulled or wrought into a compact substance without weaving.

Hair Mortar.—In building, a compost of cow's hair, lime and sand, used for plastering, finishing walls, and similar purposes, where strength and cohesion are necessary.

Half.—One of two equal parts into which anything may be divided.

Half Crossed Belting.—In millwrighting, belting is half cross when it drives between two pulleys whose axes are at right angles with each other. Half crossed belting can run only in one direction. Also called *half turn* belting.

Half Elliptic Spring.—A term applied to the laminated spring used on locomotives, and on tenders with rigid wheel base. The elliptic spring is that type in which double springs are used, giving an outline resembling an ellipse.

Half Hatchet.—A hatchet in which the blade instead of forming a half oval plane, has two straight edges and one curved.

Half Pattern.—In pattern making, one of the halves of a pattern which is *jointed through the center* for convenience of moulding.

Half Rip Saw.—In carpentry, a hand saw, containing about three and one half teeth to the inch. The teeth are so shaped as to cut *across*, as well as *lengthwise* with the grain of the wood.

Half Round.—Semi-circular in section, or with one side curved to a circular segment and the other flat. Sectional iron is made in this form for attaching, as beading or moulding, to impart a finished appearance to work or to stiffen flat sides; as, of a locomotive cab or a deck house on shipboard. *Half round files* are made in all lengths.

Half Round Bit.—A drilling instrument, shaped in cross section like half a cylinder.

Half Section.—In drawing, a sectional view which terminates at the center line, dividing the object represented into two symmetrical portions. Where a half section is given, the complementary half is usually an outside view or elevation.

Half Speed Shaft.—In automobiles, the camshaft of an ordinary four cycle explosion motor, so called because it is set by gearing to revolve once to every two revolutions of the crank. Also known as *half motion* or *half time* shaft.

Half Stuff.—In paper making, the pulp produced in the breaking or washing engine, which requires further treatment in the beating engine for the manufacture of any but the commonest paper.

Half Timbered.—In buildings, constructed of a timber frame, having the faces filled in with masonry.

Half Tone.—A photographic process for the production of engraved plates from original photographs, wash drawings and the like.

Half Turn Socket.—In oil well drilling, a fishing tool having jaws bent round in an incomplete circle, to embrace lost tools lying against the side of the well.

Halvans.—In mining, waste ore, or that from which the better part has been extracted; the attle.

Halving.—In carpentry and pattern making, the formation of a joint in two pieces of material in the same straight line, by cutting away half the thickness of each piece to form an overlap. Also termed *half lap joint*.

Halyard.—A light rope or tackle used to hoist a flag or sail.

Hambroline.—A small rope or cord used for seizings, having two strands, right handed.

Hame.—One of the two curved pieces of wood or metal in the harness of a draft horse to which the traces are attached.

Hammer.—A common utensil used for driving nails, beating metals, and the like, consisting of a head, usually metallic, but sometimes of wood or stone, fixed crosswise to a handle. Hammers are named from their use or purpose, as shoeing hammer, bush hammer, carpenters' or machinists' hammer.

Hammer Beam.—In building, a transverse horizontal beam supporting the principal rafters of a roof; as, for a church, where no ceiling is used. The *hammer beams* are supported at either end by a *wall-piece* and *strut* which form a bracket, the whole supported by a *corbel* or longitudinal rib running the length of the wall. The hammer beam may be regarded as the end of a tie beam, with its center removed.

Hammer Dressed.—In building, said of blocks of building stone which have been dressed or faced by means of the hammer alone.

Hammered Scrap.—Wrought iron or steel scrap welded together into a mass under the steam hammer. The superior soundness of small parts as compared with a large mass is held to ensure more reliable material in a forging built up by piling in this manner. Crank shafts and connecting rods were formerly made by this method.

Hammered Shafting.—Shafting which has been worked under the steam hammer. As generally understood, the term implies that the shaft has been wrought of iron or steel scrap, the whole welded and worked under the hammer.

Hammerer.—One who uses a hammer.

Hammer Hardening.—To harden; as, a metal, by hammering in the cold state.

Hammering.—A term applied by engineers to the knocking and pounding noticeable in machinery through slackly fitting parts.

Hammerman.—In blacksmithing, a smith's striker or *helper*. The man who hammers the heavier work upon the anvil with a sledge.

Hammer Mark.—In blacksmithing, the marks of the hammer left on smiths' work. Freedom from hammer marks is one of the tests of good work. The use of *flatters* tends to obliterate these marks.

Hammer Test.—A trial of the qualities of sheet metal, such as, iron, copper or steel, by the use of the hammer; such as flattening out cold to a thickness of one-half the diameter, and flattening out hot to a thickness of one-third the diameter. In neither test should they show cracks or flaws.

Hammer Tongs.—In tool making, tongs which bend at right angles and are used to hold the work in making hammers and similar work by hand.

Hammock.—A slung or swinging bed made of canvas or netting.

Hamper.—1. To hinder or restrain, to prevent freedom of motion, or to obstruct it.

2. A fetter, obstacle or clog.

3. Equipment and gear about the deck of a vessel; or elsewhere according to its qualification; as, *top hamper*.

Hancock, Walter.—Born 1799, died 1852.

An English engineer. He invented, in 1824, an original type of steam engine specially adapted for road wagons. He then devoted himself to the question of utilizing steam for the propulsion of carriages on common roads, and by his persistence in spite of early failures, he achieved a remarkable degree of success, building and operating one road wagon after another, until in 1840 he had built ten steam carriages, and made many trips in them through England. But public interest in his projects waning, he turned his attention to the manufacture of india rubber with his brother, Thomas Hancock, who had distinguished himself as the founder of the india rubber trade in England.

Hand.—A measure of length, equaling four inches.

Hand Brake.—An apparatus for checking the speed of, or stopping railroad cars, and controlled by manual power.

Hand Car.—A railway car, propelled by the aid of cranks, gearing, etc., by one or more of the passengers.

Hand Cart.—A two wheeled vehicle, intended to be pushed or pulled by hand.

Hand Drill.—1. A drilling machine fitted to be worked by manual power.

2. A light drilling apparatus in which the drill is operated by means of a fiddle bow, a swing or geared brace or a ratchet.

Handful.—A small quantity or number; as much as can be contained in the hand.

Hand Gear.—The contrivances in a steam engine for working the valves by hand; the starting gear.

Hand Grenade.—A portable fire extinguisher consisting of a glass bottle containing water and gas. It is thrown into the flames. Called also *fire grenade*.

Hand Feed.—In shop work, the feed of the cutting tools of machines by the hand of a workman in opposition to the feeding by mechanical devices; as, in planing machines, saws, etc.

Hand Hammer.—In shop practice, the machinists' working hammer used in engine and boiler work, in contradistinction to the two handed flogging hammer and the sledge.

Hand Hole.—In a steam boiler, a small opening in the outer firebox or shell, large enough to admit the hand and arm; it is closed with a small oval door, jointed on the inside, and held in position

by a dog and bolt, similar to the larger manhole of a steam boiler.

Hand Hole Plate.—In steam engineering, a plate made to cover the hand hole; this is a small hole at or near the bottom of the boiler, for the insertion of the hand in cleaning, etc.

Handicraft.—Manual occupation; work performed by the skill of the hands.

Handicraftsman.—A man who obtains his living by manual labor; one skilled in some mechanical art.

Handiwork.—Work done by the hands.

Hand Lathe.—One which has no traveling rest, the turning tools being held by the hand.

Handle.—1. That part of a vessel or instrument which is held in the hand when used; as, the bail of a kettle.

2. That of which use is made; the instrument for effecting a purpose; a tool.

Hand Lead.—A sounding apparatus consisting of a 4 pound lead weight and a light line marked off with bunting, leather or knots, at 1, 2, 3, 5, 7, 10 fathoms, etc. The unmarked fathoms are known as *deeps*.

Hand Lift.—In elevator construction, a lift or elevator worked by turning the gearing by hand. It is used in hoisting and lowering loads small distances; as, in basements of city buildings.

Hand Loom.—A loom for weaving, which is actuated by means of levers and treadles operated by the weaver himself.

Hand Nut.—A nut having wings or projections so that it may be screwed up by hand without the aid of a wrench.

Hand Pump.—A pump designed to be operated by hand; many varieties are properly included under this designation, but it is generally restricted to a small type of suction pump, with a bucket and foot valve, operated by one person; a modification is made with a delivery valve for forcing to a moderate height.

Hand Rail.—1. A protection or guard rail around machinery, etc.

2. The bars along the side of a locomotive's boiler, affording a hand hold.

Hand Ropes.—Safety lines at a gangway or ladder.

Hand Saw.—A saw to be used with the hand.

Hand Sketch.—In drawing, a rough kind of free hand drawing made without rule or compass, and although not to scale is a working drawing, because it gives all dimensions and particulars required from which to work.

Hand Spike.—A bar, usually of wood, used with the hand as a lever for various purposes; as, in raising weights, heaving about a windlass, etc.

Hand Tools.—1. All tools and implements, cutting or otherwise, which are used by the hand alone, to distinguish them from machine tools. A marine engineer classifies chisels, punches, drifts, drills for the ratchet, and scrapers as hand tools.

2. Turning tools used on a hand lathe, or on a hand rest in an engine lathe.

Hand Turning.—Turning done in a wood or iron lathe without mechanical devices for guiding and resting the hand.

Hand Vise.—A small vise used in the hand, for small work.

Hand Wheel.—Any wheel worked by hand; usually the handle by which a valve or other part is adjusted.

Handy.—Skillful in using the hand; dexterous, ready; adroit.

Hang.—To suspend; to affix to some elevated point without support from below.

Hanger.—A metal bracket or stirrup, of various shapes, used to support one of the bearings in which a line of shafting revolves. The hanger depends or hangs downwards from a beam or the like, hence its name.

Hanging Braces.—In locomotive boilers, braces or stays with flat feet riveted to the shell and the combustion chamber or firebox crown, which they support.

Hanging Wall.—In mining, the wall of a lode above the miner's head at work; the opposite of footwall.

Hang To.—A shop term, with many applications; as, a file *hangs to* its work when it cuts without slip; a saw *hangs to*, when it feels as if being drawn into the timber; a pattern *hangs to* the sand when it delivers with difficulty.

Hank.—In spinning, a parcel consisting of two or more skeins of yarn or thread tied together.

Hard.—Not easily penetrated, or separated into parts; not yielding to pressure; firm; solid; compact; applied to material bodies and opposed to soft; as, hard wood, etc.

Hard Brass.—1. Brass which has not been annealed after drawing or rolling. It is highly elastic and is therefore used for springs and work of similar character.

2. Hammered brass and brass which contains a large proportion of tin. Gun metal is often called hard brass.

Hardening.—The preliminary process of tempering edge tools; the tool, being heated to a cherry red, is plunged into brine or clear water, the sudden quenching rendering it hard enough to scratch glass. Subsequent reheating, to a point determined by experience and judgment, is necessary to *draw the temper*, so that the steel shall have those qualities of hardness and toughness, necessary for its desired duties.

Hardening Mixture.—In tool making, fluids or *semi-fluids* used for hardening and tempering steel. Most work has a mixture of its own, which is deemed possessed of peculiar powers. Pure spring water is good for the general purpose, but is often mixed with other ingredients to aid in the tempering. When thus prepared, it is called a *hardening mixture*.

Hard Grit.—A shop term for a grindstone or emery wheel of hard texture.

Hard Iron.—In steam engineering, *cast iron* which is dense and close grained. It is obtained by making suitable mixings of various brands with scrap, and is used for wearing parts, the liners of engine cylinders, and cog wheels.

Hardness.—The quality or state of being hard in any sense of the word; solidity.

Hard Patch.—A piece of metal attached to a boiler shell, used to strengthen a weak place or cover a hole, is called a *patch*. If bolted or studded it is called a *soft patch*, if riveted, a *hard patch*.

Hard Solder.—A solder which fuses only at a red heat; as, one composed of zinc and copper, or silver and copper. An alloy.

Hard Steel.—A loose and indefinite term, meaning all steel that is not *mild*; it may be taken as steel containing over $\frac{1}{2}$ of 1 per cent. of carbon.

Hardware.—Articles of general use, domestic utensils, and furnishings for houses, which are made of brass, iron, steel or tinplate, etc. The articles stocked and retailed by an ironmonger.

Hard Water.—A water in which soap will not readily dissolve, thus rendering the formation of lather difficult. Hardness may be temporary or permanent, and is due to the presence of salts, principally of lime, in solution.

Hard Wood.—There is no exact dividing line between "hard" and "soft" woods, but timber, cut from broad leaved trees, is, in carpentry, usually classed as "hard," while that from coniferous or needle leaved trees is called "soft." The wood of all conifers is very simple in its structure; the fibers, composing the main part of the wood, being all alike and their arrangement regular. The wood of broad leaved trees is complex in structure; it is made up of several different kinds of cells and fibers, and lacks the regularity of arrangement peculiar to the conifers.

Hardy.—A wedge shaped tool, mounted on a blacksmiths' anvil, serving as the bottom shear when it is desired to cut anything through with the sets.

Hardy Hole.—The square hole provided in an anvil for the reception of the hardy.

Hargreaves, James.—Died 1778. An English inventor, distinguished for the invention of the spinning jenny. At first a poor weaver, his inventive talent led to his devising an improved form of carding machine (1760) which soon supplanted the hand cards then almost universally used. In 1764 he completed his spinning jenny, by which a series of vertical spindles, each supplied with rovings from a separate spool, were operated simultaneously, producing great efficiency and economy of operation. He first employed his invention merely for his own use, until the jealousy of his neighbors led to an invasion of his home and the destruction of his frame. He then (1768) erected a spinning mill, and two years later took out a patent for his invention. Unfortunately, having sold some of his machines before applying for a patent, he found the field already occupied by imitators, so that, though his invention came into immediate and general use, he failed to reap the reward due his genius.

Harl.—Flax, hemp, hair or other fiber as drawn out after being hackled.

Harness.—In weaving, that part of a loom comprising the heddles, with their means of support and motion, by which the threads of the warp are alternately raised and depressed for the passage of the shuttle.

Harpoon.—A barbed spear, usually hurled by hand, for capturing whales.

Several hundred feet of line is attached to it which is run out as may be found necessary.

Harpoon Log.—An early pattern of self registering ship's log, the rotator being attached to the case containing the mechanism and dials; the whole being towed behind the ship. Later patterns have separated the two portions, the mechanism remaining on board while the rotator, or finny part, is alone towed at the end of the log line.

Harvester.—An agricultural implement and further development of the reaper, in which the cut grain, falling on the traveling canvas belts of a conveyer, is gathered into sheaves, bound with wire or string, and discharged clear of the machine.

Harvey, Hayward Augustus.—Born, 1824, died 1893. An American inventor. Endowed with great inventive genius, he produced many mechanical devices of great value, among which were the gimlet pointed screw, cam motion, and the toggle joint. But his chief distinction is due to the invention (1888) of a process of treating low carbon steel, by subjecting it to the action of carbonaceous material, under great pressure, at high temperature followed by violent cooling, obtaining thereby a surface of extreme hardness backed by metal of gradually varying density. This result is known as "Harveyized" steel, and its greatest value has been in the manufacture of armor plate for warships.

Hasp.—A clasp, especially one that passes over a staple to be fastened by a padlock; also, a metallic hook for fastening a door.

Hass.—With plumbers, a term signifying the inner curve of a bent pipe.

Haswell, Charles Haynes.—Born 1809, died 1907. An American Engineer. He entered the service of the U. S. Navy in 1836, and designed some of the earliest steam vessels built for the government, completing the first steam launch in 1837. In 1845, he became engineer-in-chief of the Navy, but returned to New York City in 1851, to pursue the profession of marine engineering. He published in 1843, his *Mechanics' and Engineers' Pocket Book, of Tables, Rules and Formulas*, which has been a standard ever since.

Hatch.—The crate or frame of cross bars laid over the opening in a ship's deck: also called hatches; the lid or cover of the opening in a deck or floor, or into a cellar.

Hatchel.—1. An instrument formed with long, iron teeth, set in a board, for cleaning flax or hemp from the tow, hards, or coarse parts; a kind of large comb.

2. To draw through the teeth of a hatchel; as, flax or hemp, so as to separate the coarse and refuse parts from the fine, fibrous parts.

Hatchet Bit.—A small special soldering bolt, in which the copper bit is shaped like a hatchet blade and set at right angles to the stock.

Hatchway.—A square or oblong opening in a deck or floor affording a passage from one deck or story to another.

Hat Leather.—A leather packing ring for hydraulic pump rods; so termed from its resemblance to a hat with the crown cut out. It is less yielding than the U packing. Some engineers call hat shaped packing, *pump leathers*; the cupped or U shape, *ram leathers*.

Haul.—1. To change the direction of a ship; to sail with changed course.

2. A pulling with force; a violent pull.

Haulage Drum.—In mining, a drum or pulley used to actuate a wire rope haulage system. The drum is usually connected with the engine shaft or second motion shaft by a friction clutch. Some devices have a shipping gear so that, should excessive strain be put upon the cables, as by trucks becoming derailed, the clutch will throw itself out of gear, thus stopping the rope.

Haunch.—In architecture, the middle part of an arch between the crown and the springing.

Haven.—A bay, recess, or inlet of the sea, or the mouth of a river, which affords good anchorage and a safe station for ships, a harbor; a port.

Hawse Pipe.—The pipe or conduit in a ship's bows, through which the anchor cables pass.

Hawser.—A large thick rope of hemp or manila, generally laid up left handed with three ropes, each of three right handed strands; in wire, of six strands of twelve wires, each with a hempen core in each individual strand as well as in the rope itself.

Hay Carrier.—An agricultural vehicle especially adapted for carrying hay.

Haycock Boiler.—A steam boiler shaped like a haycock; that is, in a conical form.

Hay Elevator.—An implement for stacking cut hay.

Hay Fork.—A hand fork with two or three tines, used for handling hay; also

a fork elevated by a rope and horse in unloading hay from a wagon to a mow, or vice versa.

Hay Press.—An agricultural implement, usually driven by horse power, which, being supplied with loose hay into a hopper, presses it into a bale.

Hay Ropes.—In moulding, are frequently used as a foundation upon which to build loam cores. They secure lightness and porosity.

H. B. M.—An abbreviation for His or Her Britannic Majesty.

H Branch.—In plumbing, a pipe fitting, having a branch parallel close to the main line.

Head.—1. The uppermost, foremost, or most important part of an inanimate object; as, the larger or heavier part or extremity, in distinction from the small or thinner part; or from the point or edge; as, the head of a nail, head of an axe.

2. The upper part of a roofing slate as fixed in position.

3. The upper part of a shore.

4. The top end of a pile.

5. The socket or hollow tube of a bicycle, in which works the tube carrying the front forks; ball bearings are usually fitted to it at top and bottom.

6. The depth or height of water in a vessel, pipe or conduit, which is the measure of the pressure upon any given point, below the surface when the water is at rest.

Head Block.—In a saw mill, the block upon which the forward end or head of a log rests; the farther end is supported upon a *tail block*, and the two blocks form parts of the carriage in which the log is fed to the saw.

Header.—In building, a brick laid transversely in a wall, so that its small end or head is shown; those laid longitudinally are known as *stretchers*.

Headers.—In sectional water tube boilers, those larger vertical or inclined pipes into which an element of tubes is connected, and which conduct the steam and water to the upper drum at one end and receive water from the drum at the other end.

Head Gate.—In hydraulics, vertical sliding doors, to admit, or shut off the water supply from the reservoir or intake to the flume, conveying it to a turbine or water wheel.

Heading.—1. In tunneling, a narrow preliminary passage, driven through the axial line of the work, affording access to work people, and a means of removing spoil, and which is subsequently enlarged to the full dimensions.

2. In mining, any excavation in a horizontal direction.

Heading Knife.—1. The currier's knife with one straight and one cross handle and a turned over edge, by means of which the hides are scraped to an even thickness.

2. A cooper's tool for cutting the chamfer on the edge of the head of a cask or barrel.

Heading Tool.—A blacksmith's implement, consisting of a die at the end of a stalk or handle. The die is bored to the correct shape for the necks of bolts, round or square, and the piece of bolt material is held therein while the head is formed, thus giving the correct dimensions to the neck at the same time.

Headlight.—1. Signal lamps carried at the front of a locomotive to denote the approach and character of the train.

2. A large lantern, oil, gas, or electric, carried at the base of the chimney to illuminate the track ahead.

Headlight Bracket.—A bracket or knee, on the front of a locomotive smoke box, to support the headlight.

Head Metal.—In founding, a mass of metal, usually in the form of a ring, cast on the upper end of cylindrical work, to form a receptacle for the *dross*, *sullage*, etc., which collects upon the top of molten metal. When the casting is removed from the mould, the *head metal* is turned off, leaving the actual casting smooth and free from these impurities.

Head of a Boiler.—That part of a steam boiler facing the fire room, or that part under which the fuel is placed.

Head of Water.—The height of the water above the orifice, at which it issues, and also the quantity in reserve, and the pressure resulting from either; as, a mill or reservoir has a good head of water, or ten feet head. In questions relating to pressure due to head, there are two important distinctions, viz: *static head* and *dynamic head*.

Head Race.—In hydraulics, the water course leading to the upper part of a water wheel.

Head Ropes.—The ropes at the head of a sail whereby it is secured to the yard.

Headstock.—The fixed head or poppet of a lathe, which carries the mandrel and drives the work. The movable head or poppet proper is sometimes called the *loose headstock*; the live head being known as *fast headstock*.

Head to Head Brace.—In boiler making, a through longitudinal stay, bracing the two ends or heads together; a steam space stay; a through bar stay.

Head Valve.—The delivery valve of a vertical pump, more especially of bucket pumps, such as the air pump of a marine engine.

Headway.—1. Forward motion.

2. The interval of time, or the distance, between two consecutive railway trains on the same line, and going in the same direction.

3. In coal mining, a cross heading.

Heap.—A collection of things laid or thrown together in a body; as, a scrap heap.

Heap Keeper.—A miner who superintends cleaning coal at the pit bank.

Heart.—In founding, a moulder's sleeking tool, with a heart shaped blade, a small rope in the center of a four stranded rope.

Hearth.—That part of a reverberatory furnace on which the metal is subjected to heat; the floor of a fireplace.

Hearting.—In mining, the central portion of a wall midway between the two faces.

Heart Shake.—A defective condition of timber, shown by cracks extending from the heart outwards.

Heart Wheel.—In machinery, a form of *cam*. Shaped like a heart, and used for converting rotary into reciprocating motion.

Heat.—1. A physical agent or form of energy. Heat is treated generally under the heading of *thermodynamics*, or that branch of the theory of heat which treats of the relations between heat and mechanical energy. The power which is produced by the combustion or burning of fuel. Without heat there could be no steam engine or steam boiler.

2. In founding, the metal melted at one time in the cupola.

Heater.—1. A stove or furnace, more or less portable, placed to heat some particular room or department.

2. A block of iron made red hot in a fire and then placed within an urn or a box iron.

Heater Valve or Cock.—In a locomotive, the fitting, combining, controlling, and reducing mechanism, through which steam is supplied from the boiler, at a low pressure, for heating the train.

Heating Apparatus.—The system of devices adopted for warming buildings in winter time, either by circulation of hot water, hot air, steam, or other means.

Heating of Bearings.—In machinery, bearings are said to *heat* when their temperature rises above the common so that they are subjected to a great friction strain.

Heating Surface.—That part of a steam boiler exposed to the heat generated by the furnace. Area of heating surface is frequently used to express the horse power. This is figured from the number of square feet of boiler and tube surface, exposed to the action of the fire; the extent of the heating surface of a boiler depends on the length and diameter of the shell and the number and size of the tubes or flues. For the ordinary tubular boiler, fifteen square feet of heating surface has been held to be equal to one horse power; it is also customary in calculating the heating surface of the shell, to consider that two-thirds of it is exposed to the action of heat. For internal firebox boilers twelve square feet heating surface is usually allowed per horse power.

Heat Proof Paint.—One composed of suitable ingredients so that it will not chip or flake off nor form blisters on hot surfaces, such as boiler fronts, etc. A paint containing powdered soapstone, or another with silica and graphite, is recommended.

Heat Radiation.—Radiant heat traverses air without heating it.

By means of a simple apparatus it has been ascertained that the proportion of the total heat radiated from different combustibles is as follows:

Radiated heat from wood,	- - -	nearly $\frac{1}{2}$
" " wood charcoal,	- - -	" $\frac{3}{4}$
" " oil,	- - -	" $\frac{4}{5}$

Heat Stroke.—A similar attack to sun-stroke; the worst cases occur where the sun's rays never penetrate and are caused by the extreme heat of close and confined rooms, overheated workshops, boiler-rooms, etc. The symptoms are: 1, a sudden loss of consciousness; 2, heavy breathing; 3, great heat of the skin; and 4, a marked absence of sweat.

The treatment is simple; the main thing is to lower the temperature. To do this, strip off the

clothing, apply chopped ice wrapped in flannel to the head; rub ice over the chest, and place pieces under the armpits and at the side. If no ice can be had use sheets or cloths wet with cold water, or the body can be stripped and sprinkled with cold water from a common watering pot.

Heat Units.—The unit of heat is the amount of heat required to raise the temperature of one pound of pure water 1° Fahr., at or near 39° Fahr.—the temperature of maximum density of water.

Heaved.—In mining, a vein is said to be heaved, when forced out of its place by the intersection of another vein.

Heaving Line.—A light line, weighted at one end, to heave and pass the end of a heavier rope; a nautical term.

Heavy.—Difficult to heave or lift; weighty, ponderous; burdensome or oppressive; slow, sluggish or inert.

Heavy Cut.—A shop term, used when cutting metal tools remove broad and thick shavings.

Heck.—In weaving; an apparatus through which the threads of warps pass from the bobbins to the warping mill, and by means of which they are separated into sets for the heddles.

Heck Box.—In a warping mill, a box suspended between the traverse on which the bobbins of warp yarn are mounted and the warping frame on which the yarns are wound. Its duty is to divide the warp threads into two alternate sets or leas; one set for each *heald* or *heddle*.

Heddle.—In weaving; one of the sets of parallel doubled threads which are arranged in sets, and, with their mounting, compose the harness employed to guide the warp threads to the lathe or batten; *heald*.

Heel.—In carpentry, the lower end of a stud or rafter; in plumbing, the outer curve of a bent pipe; in a ship, the list to one side or the other. Something resembling a heel, or located like a heel.

Heel Piece.—In a ship, an angle butt strap which joins the port and starboard frames together, and makes a good connection with the garboard strake.

Heel Tool.—A tool used in turning metal, whose cutting end resembles the

shape of a boot, the *heel* supported in a rest, the *toe* being the actual cutting tool, and the *handle* resting against the shoulder of the workman.

Heel Trimmer.—In a shoe factory, a machine used for trimming the edges of the heels of boots and shoes, in order to bring them to the required shape.

Heft.—1. A handle.

2. To test the weight of, by lifting or taking in the hand.

Height.—The measure or the distance to which anything rises above its foot, basis, or foundation; altitude.

Helical.—Pertaining to or having the appearance of a *helix* or screw.

Helical Seam.—A screw-like winding riveted seam, like that in a riveted sheet iron pipe, sometimes used to carry away the exhaust steam from a high pressure engine.

Helical Spring.—A spring whose coils have a gradually decreasing diameter, either lying flat in one plane like a watch spring, or assuming a conical form. The helical spring coiled on a cylinder is generally known as a *spiral spring*.

Helical Teeth.—Teeth of cog wheels which are set at an angle with the axis of the shaft, thus transmitting the motion without shock or jar, as other teeth are engaged before any particular tooth passes out of contact. To prevent end thrust, teeth are generally formed with a *V* shape, giving a *helix* both ways. This is known as *double helical gear* or *herringbone*.

Helical Wheel.—A gear wheel with spiral or angular teeth.

Heliograph.—1. The first name given to sun pictures; later called *daguerreotypes*, *photographs*, etc.

2. A mirror used for signaling by flashing rays of light from one point to another.

Helix.—The curve formed by a straight line traced on a plane when the plane is wrapped around a cylinder; as, in a screw thread; a screw or spiral. Plural *helices*.

Helm.—In navigation, the apparatus by which a ship is steered, comprising *rudder*, *tiller*, *wheel*, etc., commonly used of the tiller or wheel alone.

Helmet.—A cap or protection used in driving piles; more especially a cap filled

with sawdust, to absorb shock, used in connection with piles of armored concrete.

Help.—1. To furnish aid to, or assist in bringing about a desired result.

2. To bring relief, succor or assistance.

3. Assistance; relief; aid given.

4. An assistant or hired person; a general body of servants or assistants.

Helpers.—Unskilled laborers assisting workmen.

Helping Engine.—A locomotive specially detailed to assist trains up heavy inclines or banks.

Helve.—1. A species of tilt hammer, in which the cam comes between the tup and the fulcrum, or outside the tup.

2. The handle of an axe or hammer.

Hemisphere.—A half globe; a solid figure obtained on bisecting a sphere by a plane.

Hemlock.—A variety of spruce or fir, found along the northern border of the United States and in Canada. The trees are of medium to large size, giving a light reddish gray timber, free from resin ducts and moderately durable. The wood is rough and splintery. It is used for small scantlings, boarding, and general purposes. A larger sized hemlock, of harder and heavier timber, abounds around Puget Sound, where it is known as *Alaska fir*.

Hemlock Bark.—The bark of the hemlock tree, much used in tanning heavy leathers. It is generally used in the form of an extract, which provides a strongly concentrated *tannin* or *tannic acid*, several times more powerful than oak bark.

Hemorrhage or Bleeding.—A result of the opening of a blood vessel by a wound or otherwise; it may be external or internal. Pressure is the most powerful means of arresting external hemorrhage. To be effective press against some bone as a point of resistance. If bleeding from the extremities, place patient on his back and raise the extremity that is bleeding. Press a piece of folded cloth dipped in ice cold water on the wound and bind it on. If this is not sufficient then compress the arteries.

Hemmer.—In a sewing machine, that part which is used for turning over the edge of a fabric or garment, in order that the flap may be stitched down.

Hemp.—1. A plant, whose fibrous skin or bark is used for cloth and cordage.

2. The skin or rind of the plant prepared for spinning.

Heptagon.—In geometry, a polygon bounded by seven sides.

Hermaphrodite Calipers.—Calipers with one divider leg and one caliper leg; used to scribe center lines on a shaft or to mark out lines on a surface parallel with the edge.

Hermetic Seal.—A closure or sealing of a vessel effected by fusion, soldering or welding, so that none of its contents may escape.

Hero.—A native of Alexandria, Egypt, who flourished about 125 B. C. He was distinguished as a surgeon and civil engineer, and celebrated as a mechanician. He invented the "hydraulic clock" and a force pump for extinguishing fires, and contributed many important writings treating of mechanics and mathematics, fragments of which have been preserved. He describes the theodolite, cyclometer and steam engine, being the first to suggest steam as a motive power and at the same time illustrating the principle of the steam turbine, which was not adequately appreciated until the 20th Century.

Herringbone Gear.—Better known as double helical tooth: a type of gearing in which right and left hand spiral teeth are both used, thus giving a very gradual and even transmission of power without backlash or end play. This type of tooth is common with rolling mill trains and similar heavy gearing, and is employed for other purposes where the absence of end strain is desirable.

Herringbone Tooth.—A curved form of gear wheel tooth in which only the two ends of the tooth are opposite to each other.

Hesitates.—In hydraulics, a pump is said to "hesitate" when the motion becomes uncertain.

Hessian Suck.—A primitive form of centrifugal pump, invented about 1703 by Dennis Papin, the inventor of the safety valve, and early experimenter in steam navigation.

Hewitt, Abram Stevens.—Born 1822, died 1903. An American manufacturer and public spirited citizen. Though trained to the profession of law, his eyesight compelled him to abandon study; and thereafter, having entered into partnership with Edward Cooper, the son of Peter Cooper, he engaged in the manufacture of iron, carrying on that branch of the elder Cooper's business. In 1862, Mr. Hewitt brought from England the process of making gun-barrel iron, so that he was able to supply the material to the government during the remainder of the Civil War. The firm of Cooper and Hewitt, was the first in the U. S. to make iron girders and trusses for structural purposes, and it was Mr. Hewitt, who

introduced into America, the open-hearth process of making steel. He was a friend of the workman, maintaining his factories many years at a loss, rather than throw his men out of employment, and as secretary and treasurer of Cooper Union, founded by Peter Cooper, he brought that institution to its present degree of usefulness. His later years were distinguished by his devotion to civic betterment in New York City, and for his eminent services in advancing the cause of rapid-transit, he received in 1891, a gold medal from the Chamber of Commerce.

Hewn Stone.—Blocks of stone, the faces of which have been dressed into shape by the hammer and chisel.

Hexagon.—A geometrical figure bounded by six sides, or having six angles.

Hexagon Gauge.—A gauge of thin steel plate carefully filed to angles of 120°, so that it may be used as a check, in filing hexagons on finished nuts, etc.

Hexahedron.—A solid geometrical figure bounded by six sides; a cube.

Hexhead.—A shop term for a hexagon head screw or bolt.

Hf.—An abbreviation for *half*.

H. I.—Abbreviation for Hawaiian Islands.

Hickory.—A tree of the walnut family, the wood of which is hard, tough and heavy. There are six or seven species, the best being that of the white shagbark or shellbark hickory, distinguished from other species by shedding its bark. The wood of the hickory is extremely flexible, and is therefore used for pick handles, etc.

Hide.—In leather manufacture, the skin of a large animal, such as a horse or ox, as distinguished from *kips*, the skins of small sized or younger animals, or from the *skins* of calves, sheep, goats, etc.

Hide Mill.—In leather dressing, a machine for softening dried hides preparatory to the process of tanning. It is made in different ways: with a series of rollers, a drum or tumbling box, or a kneading apparatus.

Hiderope.—One made from twisted thongs of cowhide, and used for wheel ropes or other purposes where toughness is desired.

High.—1. That which is elevated or raised up, as opposed to that which is lowered, dropped or debased.

2. Conspicuous, superior, elevated in character or degree above surrounding conditions.

High Duty.—Said of a pumping engine which performs a large amount of work for a given unit of fuel; the number of foot pounds per 100 lbs. of coal was formerly taken as the unit of duty, but in order to eliminate the efficiency of the boiler, and grade of coal, the duty is now usually based on foot pounds of work done per 1000 pounds of dry steam. The term is also applied to those duplex pumps which have vibrating balance cylinders, which permit a high rate of expansion to be used. When the pump starts its stroke, the plungers are driven into the shell of these cylinders, compressing the air before them. The whole swings on trunnions as the pump rod advances, and when the pump has passed its half stroke and steam is cut off, the auxiliary plunger assists to drive the rod on its way, thus giving up the energy stored in it at the commencement of the stroke.

High Milling.—A process of making flour from grain by several successive grindings and intermediate sorting, instead of by a single grinding.

High Pressure.—In a steam engine, working under or sustaining a higher pressure than is customary or is the average of ordinary practice.

High Pressure Cylinder.—In a steam engine, the cylinder which first receives steam as it enters an engine from the boiler. The initial cylinder of a compound, triple, quadruple, or other steam engine in which expansion takes place in several successive stages.

High Pressure Engine.—1. A non-condensing engine, so called because the first non-condensing engines carried a high pressure, as compared with contemporary condensing ones, as the back pressure due to the atmosphere had to be overcome, while their rivals worked at or near the atmospheric pressure.

2. A simple engine; one not compounded, whether condensing or non-condensing; one which discharges its steam directly into the atmosphere.

High Pressure Steam.—That having a pressure considerably higher than atmospheric.

High Speed.—A shop term, with many significations; as, high speed engines, any engine making over 200 to 300 revolutions per minute. High speed belting applies to belts for fans, centrifugal pumps, etc., in opposition to those for line counter and other slowly driving shafts.

High Speed Bearings.—In machinery, bearings whose length is considerably greater than the diameter. Their value consists in the distribution of the excessive friction of rapidly revolving shafts over a large extent of surface, with a consequent diminution of heating.

High Speed Engine.—An indefinite term, originating with the introduction of horizontal or vertical engines which ran much quicker than the older slow moving beam engine; it signifies an engine of small or moderate size, running at a high speed of revolutions, rather than a large engine running at a high piston speed.

High Water Mark.—In surveying, etc., a reference point from which altitudes are determined, being usually the point to which the water reaches at the top of ordinary spring tides. Mean sea level will be a point half way between high and low water.

Highway.—A thoroughfare maintained by the government of a country; a public road; a passage free for all.

Hinge.—The hook or joint on which a door, gate or lid, etc., turns.

Hinged Valve.—A clack or butterfly valve; one that vibrates about one of its edges, like a door on its hinges.

Hip.—1. In building, the external angle formed by the meeting of two sloping sides of a roof, which have their wall plates running in different directions.

2. In a bridge truss, the place where an inclined end post meets the top chord.

Hip Moulding.—A moulding on the rafter which forms the hip of a roof.

Hippopotamus Hide.—In millwrighting, the animal's covering used for the exterior of buff wheels, being more elastic and durable than leather.

Hip Roof.—A roof having both sloping sides and sloping ends.

Hit.—To give a blow to; the collision of one body against another; the stroke that touches anything.

Hitch.—A catch; anything that holds, as a hook; a knot or noose in a rope, which can be readily undone, intended for a temporary fastening.

Hob.—1. A hob nail, a short thick nail with a large head, used to drive into

boot soles, thus taking the wear that would otherwise fall on the leather.

2. A hardened threaded spindle, or tool formed like a worm, by means of which chasing combs, dies, or worm wheels are cut.

3. An iron shelf beside a grate or fireplace.

Hod.—1. A portable trough, with two sloping sides and an end fixed crosswise on the end of a handle or pole. It is used for carrying bricks, mortar, etc., and is borne upon the shoulders of the laborer, the V edge resting upon a leather pad.

2. A box or scuttle for holding coal or for carrying it from room to room; as, a coal hod.

Hod Carrier.—In building, an attendant on masons, supplying them with bricks or mortar; a hod man.

Hoe, Richard March.—Born 1812, died 1886. An American inventor and manufacturer of printing presses. He was early identified with his father who had invented the original Hoe press, and by diligent application to the development of printing press manufacture became, at his father's death, the head of the firm. Thereafter, he invented many important improvements, bringing out the rotary press known as "Hoe's Lightning Press" for rapid newspaper work, in 1846; this was followed by the web perfecting press by which newspapers were printed upon both sides of the sheet at once, and cut and folded by the same machine in a continuous process, so that 15,000 to 20,000 papers an hour were prepared for delivery. Later improvements were frequently made, leading to the present perfection of the printing press, and giving to the name of Hoe a pre-eminence in the field of printing press manufacture.

Hoe.—An implement for digging, and cleaning, having, in its simplest form, a flat, thin blade, set nearly at right angles to a long, straight handle.

Hog.—A machine in sawmills for grinding and cutting waste bits of wood into small chips. These chips with the sawdust are carried by elevators to the furnaces.

Hogback.—In mining, a sudden upward curve in the floor of a coal seam.

Hog Chain.—1. A tie chain or tie rod passing over straining posts in a vessel to prevent hogging.

2. A chain used in bridge construction.

Hog Frame.—A truss or girder, built as a fore and aft frame on light draught steamers of large size; the hog frame is usually above deck and stiffens the hull.

Hogging.—In a ship, the strain when she is supported at the middle only, and the

weight of her ends arches her like the back of a hog; the opposite of sagging.

Hog Nose Roughing Tool.—In shop work, a cutting tool used for roughing work in a boring mill; it resembles the ordinary round nose roughing tool, but is rather sharper at the point, and has a little top rake.

Hogshead.—1. A liquid measure containing 63 U. S. gallons; or 52½ Imperial gallons.

2. A cask containing from 100 to 140 gallons, as used for molasses, sugar, tobacco, etc.; the measures having local acceptance.

Hog Yoke.—In navigation, a sextant for observing angles or the altitude of the heavenly bodies.

Hoist.—A name applied to a mechanism which raises things; as, ashes, ammunition, coal, for the customary duties of a ship as apart from cargo; an elevator.

Hoisting Engine.—1. A variety of steam winch employed to hoist materials from one level to another; as, in an excavation or in the erection of a tall building. Wire or hemp ropes are usually employed, passing over single sheaves and coiling up on winding drums.

2. The engine which raises or lowers, within a mine shaft, the cages containing men and minerals.

Hoist Tower.—In a blast furnace, the high structure upon which works the apparatus which elevates the fuel, ore and flux to the summit of the furnace.

Hold.—The whole interior cavity of a vessel in which the cargo, etc., is stowed; divided into the after hold, which lies abaft the main mast, the main hold, immediately before the main mast, and the fore hold, about the fore hatchway.

Holder.—1. One who or that which holds.

2. A stock, haft or handle to which removable tool points may be affixed.

3. A contrivance for gripping small parts which have to be operated upon.

4. A device to secure in place any part or adjunct which may have to be frequently moved for adjustment or renewal.

Holdfast.—In building, a spike, with a clip or loop at the end, driven into brickwork in order to secure pipes, or other articles to a wall.

Holding Down Bolts.—Those bolts that fasten the engine framing to its seating and foundations.

Hole.—An opening running or made through a body; hollow, cave, excavation; as, holes punched in leather.

Hollander.—In paper making, a name given to the washing or breaking engine.

Holley, Alexander Lyman.—Born 1832, died 1882. An American engineer and metallurgist. He early became an expert machinist and was employed in a Corliss engine works; later he became editor and part owner of the *Railroad Advocate* (1854) and published important contributions on railway and engineering subjects; in 1863 he bought the American license to the Bessemer process for making steel, and in 1865 built a Bessemer steel plant in Troy, N. Y., which was followed by his building several other plants in various parts of the U. S.; in 1875 he was elected president of the Institute of Mining Engineers, and the next year helped to found the American Society of Mechanical Engineers.

Hollow.—A cavity, natural or artificial; an unfilled space within anything; a low spot surrounded by elevations.

Hollowing Plane.—In carpentry, a plane to smooth concave surfaces, the sole of the plane being rounded or struck to a convex arc.

Hollow Mill.—A species of crown cutter used to dress out annular grooves, or to machine bosses and circular projections. Usually made expanding, the teeth being adjustable by means of a ring sliding over them.

Hollow Quoin.—In carpentry, a cylindrical recess in which the gates of a lock, etc., are hinged.

Hollow Shaft.—A shaft which is made tubular through having the central portion removed by boring, etc.

Hollow Spindle Lathe.—One in which the mandrel is tubular, the rod or bar to be operated upon being fed through the chuck as required.

Hollow Stay Bolt.—In locomotives, short stay bolts with a hole bored from end to end. These are used in the side of the boilers at the top of the fire line as a safety device, to give notice whether the stay bolts have been weakened by corrosion. This ingenious device is in use to show when a bolt has broken. A small hole is drilled into the head, extending a little way beyond the plate, and as experience shows that the fracture nearly always occurs next to the outside plate, that is the end taken for the bored out head; when the bolt is broken, the rush of steam through the small hole shows the danger without causing serious disturbance.

Hollow Tile.—Clay moulded into cellular forms and baked. This material is used in fireproof construction for floors, partitions and the casing around pillars and girders. There are two broadly marked classes: (1) porous tiling, in which sawdust and chopped straw are mixed with fine clay, and on burning the sawdust is consumed leaving the tiling spongy and porous, like pumice stone; (2) hollow pottery, in which the dense clay is moulded into the cellular shapes demanded for constructive work.

Hollow Ware.—Domestic utensils and culinary vessels of cast iron, such as pots, kettles, pans, etc. Also similar vessels made of tin plate, and those glass manufacturers which are blown.

Holy Stone.—In navigation, a stone used by seamen to scrub the deck of a vessel.

Home Signal.—A block signal semaphore, placed so as to protect a train standing within the station or section which it covers. Approaching trains are required to stop short of this signal if it stands at danger.

Hommock.—A small eminence of a conical form, of land or ice; a knoll; a hillock; also spelled hummock.

Homogeneous.—Of the same kind or nature; hence, homogeneous, as applied to boiler plates, means even grained. In steel plates there are no layers of fibers, and the metal is as strong one way as another.

Hone.—A slab or stone of fine grit, used for sharpening tools and instruments that require a delicate edge; it differs from an ordinary whetstone in being of much finer grit. Also known as an *oilstone*.

Honey Comb Radiator.—In an automobile, a cellular radiator which is pierced with square holes, like the comb of wax which holds honey. Also applied to radiators pierced with holes of other shapes, but bearing some resemblance to a honeycomb.

Hood.—1. A dome shaped projection or canopy over an orifice; as, a ventilator or chimney; so termed from its resemblance to a hood when drawn over the head.

2. The covering or carriage top of a vehicle properly, one that may be elevated or depressed as required.

3. A protection or covering over anything resembling a hood in appearance.

4. The bonnet or covering over the mechanism of a motor car.

Hook.—1. A piece of metal or other hard material, bent into a curve, for catching, holding or sustaining, something else; as, a fish hook, bale hook, coat hook, etc.

2. A firing tool, consisting of a long handle with a point projecting from it, at right angles, used to clear fire, or for clearing the air space between the grate.

Hook Bolt.—A bolt having a hook instead of a head; hook bolts are used to secure corrugated iron roofing, the hook engaging with the angle iron purline, and the nut and washer locking the sheet down in its place.

Hoop.—1. A strip of metal or wood, joined together at the ends so as to make a ring.

2. A band of iron around a millstone to strengthen it against the effects of centrifugal force.

3. The strap of an eccentric.

Hoop Driver.—1. A hand tool, like a socket chisel with a caulking tool point, which is used by coopers when forcing hoops on the staves of a cask. The hoop driver is placed on the hoop and its handle beaten with the hammer or mallet.

2. A machine by which hoops are forced on simultaneously.

Hoop Guide.—A machine for guiding wooden hoops on to the staves of barrels and casks, in connection with a hoop driving machine.

Hoop Iron.—Long narrow thin strips, used as hoops to secure the staves of casks, to fasten bales of merchandise together, etc.

Hoop Iron Bond.—In building, a tying piece of thin sheet or hoop iron, placed transversely to the courses of brick in a wall to bond them together; the irons require to be painted or galvanized to prevent corrosion.

Hoop Riving Machine.—A machine for riving or splitting out the bars or bands of wood, from a log, which are to be made into hoops for cooperage. The logs are operated upon by gangs of circular saws, set to proper distances.

Hoop Splaying Machine.—One in which hoop iron is coiled in rings suitable for fitting the cask and at the same time coned or splayed so as to fit the taper of the bilge.

Hoop Stress.—The bursting stress on the shells of thick cylinders, such as those for hydraulic pumps. The stress is greatest at the bore, diminishing in intensity as it passes to the exterior, and for the purposes of investigation, the wall or shell is supposed to be composed of a number of concentric hoops or rings.

Hopper.—1. In flour milling, a conduit, shaped as an inverted cone or pyramid, to supply grain to millstones, or perform similar services to other machinery. Originally provided with a dancing or hopping motion, to shake the grain free, and strew it equally.

2. In engineering, a tapering conduit leading from the underside of the smoke box, between the wheels, and closed by a shutter, so that cinders, etc., can be allowed to fall from the bottom of the smoke box. Also known as *front-end hopper*, *cinder chute*, etc.

Hopper Boy.—A device in a flouring mill, in which a revolving rake draws the ground meal over a discharge opening in the floor, for the purpose of cooling the meal preparatory to bolting.

Hopper Dredger.—A floating dredger, excavating by any system, which has a hold or well, to receive the material dredged; fitted with a hopper bottom to dump it.

Horizon.—An imaginary circle touching the earth and bounded by the line in which the earth and sky seem to meet.

Horizontal.—Parallel to the horizon; extending in a flat level surface like that of still water; at right angles to the influence of gravity at any point.

Horizontal Engine.—One in which the force is exerted in a horizontal direction, or its principal parts lie in a level horizontal plane. A horizontal engine therefore is one whose cylinder lies horizontally, its piston or most important part reciprocating horizontally.

Horizontal Jack.—A form of hydraulic jack.

Horizontal Line.—In drawing, one parallel to the top or bottom of the paper.

Horizontal Plane.—A plane parallel to the horizon, without inclination towards it. In perspective, a plane parallel to the horizon, passing through the eye and cutting the perspective plane at right angles.

Horizontal Tubular Boiler.—In this type, the shell is filled with as many small tubes, varying from two inches to four inches in diameter, as is consistent with the circulation and steam space. In firing, the combustion first takes place under the shell, and the products, such as heat, flame, and gas, pass through the small tubes to the chimney.

Horn.—1. In carpentry, a curved projection on the fore part of a plane.

2. In navigation, the outer end of a crosstree. Also one of the projections forming the jaws of a gaff boom, etc.

Horn Beam.—A tree, having a smooth, gray bark and a ridged trunk, the wood being white and very hard. Also called *iron wood*.

Horn Block.—In railway car construction, the frame or pedestal in which a railway car axle box slides up and down. Also called *horn plate*.

Hornblower, Jonathan Carter.—Born 1753, died 1815. An English engineer. He inherited mechanical abilities from his father and grandfather who were identified with the early development of the steam engine. His invention of the "double-beat valve" brought him into prominence. He was employed by James Watt, to assist in the erection of certain new engines, but, when familiar with details of Watt's engines, he proceeded to construct a steam engine of his own which he patented in 1781. In a suit for infringement brought by Watt, Hornblower lost. Yet he undoubtedly first anticipated the principle of the compound engine and first attempted to use steam expansively. In 1798 and 1805, he patented other engines of less value than the first.

Horn Book.—A child's primer, as formerly made, consisting of a thin board of oak or a slip of paper, with the nine digits, the alphabet, and the Lord's prayer, printed upon it, covered with a thin layer of transparent horn, and framed.

Horn Drum.—In hydraulics, a wheel with long curved scoops for raising water.

Horn Gate.—In moulding, a sort of runner stick curved at the lower end, used to form a sprue leading from the upper surface to the bottom of the mould.

Horn Plates.—In a locomotive, the arms or horns between which the axle box works; also known as *axle guard*.

Horn Slate.—In civil engineering, a gray siliceous stone used in construction.

Horn Socket.—In well boring, an implement to recover lost tools, especially broken drill poles, etc. It consists of a conical socket, the larger end downwards, which slides over the broken part, a spring latch gripping it when entered. Frequently a flaring mouthpiece is riveted to the horn socket, making it a *bell mouth socket*.

Horology.—The science of principles and construction of time pieces; as, watches, clocks, etc.

Horse.—In mining, a sudden rise and fall in the seam; a swell; known in South Wales as a *swine back*.

Horse Box.—An English railway car, on four wheels, fitted with slings and padded partitions for the transportation of horses and valuable cattle, and having accommodation for attendants.

Horse Car.—1. A box car fitted up with varying degrees of elaboration for the transportation of horses or other valuable live stock.

2. A street railway car drawn by horses.

Horse Gear.—An agricultural implement, consisting of a combination of gearing in a frame, used to convert the motion of one or more horses harnessed to the levers of the machine and traveling in a circular path around it.

Horse Gin.—A gin or mill driven by a horse; usually a drum or *capstan* mounted upon a vertical shaft, revolved by a horse traveling in a circular path; used to wind minerals from shallow depths; as, in quarries or open workings.

Horse Mill.—A mechanism for usefully applying the power exerted by a horse traveling around a circular path. Similar to a *horse gear* or *power*; a mill driven by a horse.

Horse Power.—33,000 foot pounds, or in other words, 33,000 pounds lifted one foot in one minute, or one pound lifted 33,000 feet in one minute, or 550 pounds lifted one foot in one second. Horse power involves three elements: (1) force, (2) distance, (3) time. If we express the force in pounds and the distance passed through in feet, we have a solution of, and the meaning for, the term *foot pounds*; from which it will be seen that a foot pound is a resistance equal to one pound moved one foot.

2. An arrangement of bevel and spur gearing within a frame, whereby the slow effort of a horse traveling around a circular path is translated into the rapid revolutions of a shaft, suitable for driving the smaller machinery of a farm, etc. The same as *horse gear*.

[NOTE.—James Watt was early asked by would-be purchasers as to how many horses his engines would replace. To obtain data as to actual performance in continuous work, he experimented with powerful brewery horses, and found that one traveling at $2\frac{1}{2}$ miles per hour, or 220 feet per minute, and harnessed to a rope leading over a pulley and down a vertical shaft, could haul up a weight averaging 100 lbs., equaling 22,000 foot pounds per minute. To give good measure, Watt increased the measurement by 50%, thus getting the familiar unit of 33,000 minute foot pounds.]

Horse Power of a Locomotive.—The term horse power is not generally used in speaking of a locomotive, as the character of the work is quite different from that of a stationary engine. The power of the locomotive resides in two places: (1) the adhesive power, which is derived from the weight on the driving wheels and their friction and adhesion on the rails, it being remembered that the adhesion varies with the weight on the drivers and the state of the rail; (2) the tractive power of the locomotive, which is that derived from the pressure of the steam on the piston applied to the cranks and revolving wheels.

Horse Power of a Pump.—Is the same as is used to designate that of a steam engine.

Horse Power of Steam Boilers.—The usual value given to the term horse power as applied to boilers is the evaporation of thirty pounds of water per hour, from feed water of 100° Fahrenheit into steam at 70 lbs. gauge pressure, which in standard tests is considered to be equal to $34\frac{1}{2}$ pounds of water evaporated from a feed water temperature of 212° F. into steam, at the same temperature. This standard is equal to 3396 B. T. U. per hour. Some engines can develop a horse power on this number of pounds of steam per hour, others cannot, while many require more, hence it is about the present average capacity. Both engineers and steam users have accepted this standard.

Horse Power Transmitted by Leather Belts.—In a single leather belt, not overstrained, a speed of 1000 feet per minute for each inch in width, is estimated to convey one horse power.

Horse Rasp.—The file or rasp used by farriers to trim a horse's hoofs while shoeing him.

Horse Shoe.—In a steamship, the wearing part of a thrust bearing, which abuts against the collars of the shaft, and transmits the thrust to the hull of the ship; so called on account of its shape.

Hose.—A flexible pipe, made of rubber, leather, and various other materials, and used for conveying fluids, especially water, to extinguish fires, etc.

Hose Coupling.—1. In an air brake, a coupling designed to connect the flexible air pipes at the end of railway cars, the purpose sought and attained being, to make a rigid and air tight connection between two faces with one motion. With the vacuum brake, this is effected by making the couplings exactly alike, with horns on the top and bottom, so that it is impossible to couple them up wrongly.

2. A connection for lengths of hose, or to unite a hose with a fitting. The nut or female portion is loose on the socket of that end, so that the joint is exactly similar to a lip union, the contact being between internal and external cones.

Hose Reel.—A small carriage, on which to wind hose for garden or stable purposes. On a larger scale, where used in connection with a steam fire engine, usually called a *hose carriage*.

Hose Valve.—A globe or stop valve, either angle or straightway, with a female pipe thread connection, usually 2" or $2\frac{1}{2}$ " on one branch, and the other end screwed to a male thread to fit a hose coupling. These valves are placed at suitable points along a pressure fire main system.

Hot.—Having the sensation of heat in a high degree, or possessing or communicating sensible heat. In both senses, the term implies a marked degree of heat, the lower degrees being known as *warm*.

Hot Air Engine.—A prime mover which uses heated air for its working fluid, the principle of its action depending upon the alternate heating and cooling of the air employed. The lower part of the vertical cylinder is exposed to the source of heat in such a manner that the internal air becomes rapidly heated and expands, doing work upon a *power piston*. The heated air exhausts through a regenerator or inter-changer, where it parts with some of its heat to incoming air and passes into the compression cylinder, where it is rapidly cooled, by means of a water jacket, etc., and is then sent back by another piston through the regenerator to perform the same cycle once more.

Hot Blast.—Hot air furnace; a forcible stream of hot air blown into a furnace so as to melt iron ore.

Hot Box.—In railways, a colloquial expression for an overheated axle or journal box.

Hot Flue.—In textile manufactures, an apartment heated by stoves or steam pipes, in which padded and printed calicoes are dried.

Hot Head Ignition.—In an oil engine, a method of exploding the charge by means of heat applied to a portion of the cylinder cover or head.

Hot Neck.—A journal or neck which is subject to heat; as, in a *calender* roll, which is heated within by steam. Such bearings require very careful lubrication.

Hot Pressed.—Pressed while heat is applied, for the purpose of giving a smooth and glossy surface; as, paper and the like.

Hot Saw.—A circular saw used for cutting iron sections, rails, etc., to the proper length, while still heated; any circular saw for cutting hot metals.

Hot Set.—In blacksmithing, a cutting implement used to dress hot iron. The blade is much thinner and keener than the cold set.

Hot Short.—More or less brittle when heated; as, hot short iron.

Hot Tests.—In metals, the testing of iron and steel bars and plates by bending them *hot* to a certain angle, both with and across the grain.

Hot Tube.—A tube or pipe lined inside with porcelain, to enable it to withstand firing through without excessive oxidization.

Hot Tube Ignition.—In an internal combustion engine, a method of igniting the explosive mixture by contact with a heated tube of platinum, porcelain, or nickel alloy. The tube which is closed at its far end, is maintained at a red heat by an external Bunsen flame; at the proper moment, the *timing valve* opens communication between the cylinder clearance and the open end of the hot tube, the explosion following.

Hot Water Heating.—A method of warming rooms and passages in a building, by means of hot water circulated through pipes. The water circulates solely by convection, rising from the boiler, passing through the various coils and returning again by separate pipes. The system is kept full from an elevated tank, with ball valve, situated above the highest heating coil. The pressure is thus that due to the head of water alone, permitting the use of cast iron boilers. There are two systems of hot water heating, viz: *The open tank system* in which the working temperature is usually between 200° and 212° F., and the *closed system* in which the tank is closed. The cost of hot water heating is greater than that of steam heating on account of the larger radiating surfaces required.

Hot Water Jacket.—A portion of a heating apparatus, consisting of a cylinder, in which the circulating water is heated by contact with a coiled steam pipe, or a similar apparatus for retaining heat.

Hot Well.—In a condensing engine, a receptacle for the hot water drawn from the condenser by the air pump. In marine practice, this water is returned to the boiler, being drawn from the hot well by the feed pump.

Hounding.—In navigation, that portion of a mast between the deck and the top of the hounds.

Hounds.—Projections on the masthead serving to support the trestle trees.

Hour.—The twenty-fourth part of a day; sixty minutes.

Hour Glass.—An instrument for measuring time, especially the interval of an hour, consisting of a glass vessel having two compartments, from the uppermost of which a quantity of sand, water, or mercury occupies an hour in running through a small aperture into the lower.

Hour Glass Screw.—In worm gearing, a worm or tangent screw, which transmits motion to a worm wheel. It is used when a large reduction in motion is required, and derives its name from its resemblance to the form of a sand hour glass.

House.—A building or edifice for the habitation of man; a dwelling place, or abode.

House Boat.—A covered boat; a raft or hull, bearing a house, used as a residence, or to afford living accommodation for persons employed along a waterway.

House of Call.—A place, usually a public house where journeymen, connected with a particular trade, assemble when out of work, ready for the call of employers.

Housing.—1. The brackets or frames which support a bearing, especially the supports for the bearings of rolls in an iron rolling mill.

2. The standards which support the cross rail of a planing machine or boring mill.

3. Notches cut by a carpenter into stringer boards to support the ends of a stair, or similar notches cut elsewhere.

4. A guard or protection to enclose small machinery, gearing, etc., to prevent it from damage or derangement by objects coming into contact with it.

5. That part of a mast between the keelson and the upper deck.

Howe, Elias.—Born 1819, died 1867. An American inventor famous for his one invention, the sewing machine. He commenced in 1843 to work out his designs which were completed in 1845. His ideas were pirated and he met great opposition; however, he finally established his patent and successfully carried on the manufacture of machines, receiving in 1867 a gold medal and the Cross of the Legion of Honor, at the Paris Exposition.

Howel.—In cooperage, a plane with a convex sole, used for smoothing the insides of barrels and casks, making the smooth circle at the *croze*, and also the *chamfer* on the inside of the *chine*.

Howe Truss.—In bridge building, a truss or lattice girder. Its characteristics are diagonal struts or compression members crossing each other to form an X or St. Andrews cross, while the iron bolts or rods between each pair of X's act as ties.

H. P.—Abbreviation for horse power, or high pressure.

H. P. Cyl.—Abbreviation for the high pressure cylinder of a steam engine.

H Piece.—In a plunger or force pump, a piece standing on the windbore under the door piece, by which the water is forced through the door piece and up into the stand pipe.

H. R. H.—Abbreviation for His (or Her) Royal Highness.

Hub.—The central portion of a wheel from which the spokes radiate, and which is bored for the reception of the axle; the nave of a wheel.

Hub Chain Wheel.—In a bicycle, the sprocket on the hub of the driving wheel, by means of which the drive of the chain is transmitted from the crank.

Hulling Machine.—A machine for removing hulls from grain, usually without crushing the kernel. They are practically grinding mills using rotating stones or roughened revolving cylinders.

Humidity.—The watery vapor always present in the atmosphere; it varies with the temperature, being greater during

warm weather. The degree of saturation, or relative humidity of the air is determined by the use of the wet and dry bulb thermometers.

Hump.—In hydraulics, this is an arch or bend which causes an "air pocket" in a water pipe line.

Hunting.—A term applied to an in and out motion, or when any mechanism runs unsteadily, either too fast or too slow, especially in a centrifugal governor, when the governor is unduly sensitive.

Hunting Cog.—An extra tooth fitted into one of a pair of toothed wheels, so that the teeth in either wheel shall not be exact multiples or factors of each other. This prevents the same teeth from coming too often together, and so equalizes the wear.

Hunting Gear.—A mechanism in a steering engine, reversing gear or marine governor, by which the piston of a steam cylinder is constrained to follow the motion of a hand lever or wheel.

Huntsman, Benjamin.—Born 1704, died 1776. An English mechanic and inventor. He commenced business as a clockmaker, but, realizing the poor quality of steel available for making the important parts of a clock, resolved upon improving the quality of the metal. His experiments continued for a considerable period in secret, resulting in the final development of a method of purifying the raw steel by subjecting it to certain oxidizing fluxes under intense heat in closed earthenware crucibles. The process was not patented, but was guarded by secrecy for many years, and steel so made rapidly supplanted the ordinary steel for making cutlery and small mechanical parts. The time had not yet come for the making of cast steel on an extensive scale.

Hurdy Gurdy Wheel.—In hydraulics, an impulse water wheel, several forms of which were invented by miners of Nevada and California. It is especially noteworthy for its use of extremely high heads of water, the fluid being directed on the wheel buckets by means of a conical nozzle. The Pelton wheel is the most efficient, deriving its value from the shape of the interior of its buckets, which split up the cone of water on a sharp edge and produce a re-action curve on either side with no dead water or agitation. This form of water wheel, named by reason of its small size and rapid rotation from the old musical instrument, is the most efficient water motor known.

Husk Frame.—The wooden frame which sets over a millstone, so arranged as to keep the ground grain or meal from escaping except through the "spout."

Hussey, Obed.—Born 1791, died 1859.

An American inventor. A skillful mechanic, he made many ingenious and useful inventions, among which are deserving of mention: a steam plow, an ice making machine, a cane crusher, and a machine for making hooks and eyes. But his great achievement was the invention of a mowing and reaping machine (1833), which incorporated numerous important details not hitherto known. Complications over patent rights involved him in considerable dispute with C. H. McCormick, but Hussey's improvements were established beyond doubt as exclusively his own. Of these, the cutting device was especially valuable and indispensable. Even Mr. McCormick himself was compelled to adopt it in the manufacture of his own reapers, in order to keep pace with his rival.

Hutch.—In mining, a box for containing ore, in various processes of treatment.

Hydrant.—A hollow cylindrical post fitted with valves and nozzles, to give connections from a street water main to several lines of hose for water supply.

Hydraulic Accumulator.—Its use is to secure a uniform pressure of water in a reservoir by weight, so that however much or little of this water is used the pressure will remain constant. The accumulator is used in conjunction with a pump, working steadily, and capable of supplying a number of machines, working intermittently, the power being stored up in raising the accumulator to its full stroke. Thus, three machines, working intermittently for one minute each out of five, and each requiring ten horse power during that period, can be handled easily by a pump with a continuous output of only six horse power.

Hydraulic Belt.—A traveling belt of porous woolen fabric, which dips into water at its lower part; moving at a high speed it picks up the water and the layer or film adhering to the belt can be carried to a high level, thus forming a pump without valves or passages.

Hydraulic Bolt Extractor.—A modification of the hydraulic jack employed to force out coupling bolts; the ram has a central "dolly" or bar of steel, and if the bolt refuses to move, a sharp blow on the dolly will generally start it as soon as a fair pressure is reached.

Hydraulic Capstan.—A capstan driven usually by two oscillating hydraulic cylinders, as employed on docks and in railway freight yards.

Hydraulic Cement.—Manufactured compounds that "set" or harden under water. Some of these set under water in from three to four minutes,

others require as many hours. They do not shrink in hardening, and make an excellent mortar without sand.

Hydraulic Crane.—A crane driven by a hydraulic ram or piston; the stroke of the ram being multiplied several times by means of a pulley system, thus giving a long rapid lift.

Hydraulic Derrick.—A development of the hydraulic crane, fitted with three hydraulic cylinders, one for topping the boom, the second for hoisting, and the third for slewing. Any or all of these may be made double.

Hydraulic Engine.—One driven by water under pressure, either from an elevated reservoir or from a loaded accumulator. The general design of a hydraulic engine resembles a steam engine, and it works on the same principles.

Hydraulic Fit.—The same as force fit; that is, a fit in which the male part is so much larger than the female that a hydraulic press is necessary to force them together.

Hydraulic Glue.—Glue which has the character of resisting the action of moisture. It is made by dissolving glue in skimmed milk, or by adding a little linseed oil and oxide of iron to ordinary glue.

Hydraulic Intensifier.—A cylinder having two diameters, operating like a tandem compound engine. It is used for increasing the pressure of water in hydraulic mains, pipes or machines, using only the energy of the pressure water to effect the change. But for this distinction, a steam pump would be an intensifier.

Hydraulic Jack.—A jack used for lifting heavy weights, the load on which is moved by a hydraulic plunger instead of a screw. The plunger is actuated by a small pump, whose water supply is contained in the head of the jack. This has been called the seventh mechanical power.

Hydraulic Lime.—One possessing the property of hardening under water. Limes containing 8 to 12 per cent. of silica, alumina, etc., set slowly in water, those containing 12 to 20 per cent. of the same ingredients set in six or eight days, those termed eminently hydraulic, and possessing 30 to 50 per cent. of foreign matter harden in 2 to 4 days.

Hydraulic Machinery.—A general name for all mechanisms actuated by water pressure. Many advantages accrue to hydraulic transmission of power, and it is especially useful for intermittent working; as, with cranes, elevators, small motors, etc.

Hydraulic Main.—In gas making, the large pipe, partly filled with water, into which the dip pipes discharge the gases, etc., coming from the retorts.

Hydraulic Mining.—A method of mining in which a bank of gold bearing earth or gravel, is washed away by a powerful jet of water; the dislodged material being passed over sluices to recover ore, etc. This method of mining, formerly largely practiced, has been proclaimed illegal nearly everywhere, as it is productive of landslips, and accidents to neighboring properties and water courses.

Hydraulic Pivots.—A film of oil or water forced under the end of an upright shaft to absorb friction and sustain the weight.

Hydraulic Press.—A machine for exerting great pressure, deriving its power from a hydraulic ram. This was the earliest application of such power, and was invented by Bramah; its principles depend upon the incompressibility of water, and the property possessed by fluids of pressing equally upon the walls of the vessel containing them. Thus, in a boiler full of water, a pressure of 100 lbs. exerted upon a pump ram of one inch area, will exert a pressure of 100 lbs. per square inch over the whole of the interior surfaces of the boiler.

Hydraulic Ram.—A device whereby the energy of a fall of water is made to force a portion of the water to a great height. The water working the ram is supplied through a sloping pipe, and escapes through an opening; when its velocity exceeds a certain rate, it closes this opening by means of a balanced valve, which is made as light as consistent with strength; the sudden stoppage creates intense pressure in the ram and opens a delivery valve into an air vessel, and thence drives the water through the delivery pipe to its destination. As soon as equilibrium is restored, the delivery valve closes, the waste opens and the cycle recommences.

Hydraulic Riveting Machine.—A mechanism for closing rivets by water pressure. It consists of a yoke or jaw on one arm of which is a hydraulic cylinder, whose piston rod is furnished with a die for closing the rivet head, while the second die is "held up" by the other arm of the yoke. These machines are either of large size and stationary, the work being brought to them by cranes, or else are slung on cranes themselves over the work, the water being supplied by coiled, flexible, copper tubing.

Hydraulics.—The science relating to liquids in motion, dealing with their useful application; the purely theoretical consideration of their movements being termed *hydrodynamics*.

Hydraulic Test.—A method of testing the tightness of the joints in a boiler by the use of a hydraulic pump. Warm water 120° to 150° should be used, as the boiler has to be warm when doing its work, and cold water is an unfair test.

Hydraulic Turbine.—One driven by water pressure or impulse, as distinguished from one actuated by steam or other fluid.

Hydrocarbon.—A compound of hydrogen and carbon; the possible number of these compounds is infinite, and the known number very large. The most important are: (1) paraffins, (2) olefines, (3) acetylenes, (4) benzenes or aromatic series. To the first belong gases, liquids and solids, like marsh gas, petroleum, ozokerite and jet. Illuminating gas, generally consists of hydrogen combined with olefines and acetylenes. The benzenes in one form or another cover an immense range, carbolic acid, essential oils, tannic acid, all being formed therefrom.

Hydrochloric Acid.—A colorless gas obtained by heating common salt (sodium chloride) with sulphuric acid.

Hydrodynamic.—Pertaining to, or derived from, the moving action of water or a liquid; of or pertaining to *water power*.

Hydroelectric Generator.—A term for a generating set or unit in which a dynamo is coupled directly to a turbine or other water wheel.

Hydrofluoric Acid.—An acid prepared like hydrochloric acid, by the action of strong sulphuric acid on powdered fluor spar.

Hydrogen.—A colorless, odorless, tasteless gas, the lightest body known. Its specific gravity is taken as 1, air being 14.4. It is combustible, burning with an almost invisible flame, if pure, and forming water by union with the oxygen of the air; it is a non-supporter of combustion. Hydrogen liquefies under great pressure and low temperature, solidifying at 431° Fahr.

Hydrokinetic.—In physics, of or pertaining to the motions of fluids, or the forces which produce or effect such motions; opposed to *hydrostatic*.

Hydrometer.—An instrument constructed for the purpose of ascertaining the specific gravities of liquids.

Hydro Pneumatics.—The science dealing with the combined action of water and air, or the action of water and a gas.

Hydrostatic Balance.—A balance for weighing substances in water, for the purpose of ascertaining their specific gravities.

Hydrostatic Bed.—In hydraulics, a water bed; as, that of a pond.

Hydrostatic Joint.—Used in large water mains in which sheet lead is forced tightly into the bell of a pipe by means of the hydrostatic pressure of a liquid, preferably tar.

Hydrostatic Level.—An ingenious method of ascertaining whether walls, etc., are level with each other, although wide spaces intervene. Two large graduated vessels, resembling beakers, are connected near their bases by flexible rubber tubes. On filling them with water and placing a beaker on either wall to be compared, the height in each graduated vessel will at once proclaim the relative level of each surface.

Hydrostatic Paradox.—The principle that any quantity of fluid however small may balance any weight however great.

Hydrostatic Press.—In hydraulics, a machine in which great force, with slow motion is communicated to a large plunger by means of water forced into the cylinder in which it moves, by a forcing pump of small diameter, to which the power is applied, the principle involved being the same as in the hydrostatic bellows. Also called *Bramah press*.

Hydrostatics.—That branch of physics which treats of the laws governing fluids at rest, as distinguished from hydraulics which refers to them in motion.

Hydroxyl.—An unisolated compound radical (HO) which occurs in alcohols, most acids, and many organic compounds.

Hygrometer.—An instrument for measuring the proportion of aqueous vapor in the atmosphere; a usual form is that known as the wet and dry bulb thermometer. This consists of two equal thermometers mounted side by side, the bulb of one being kept moist by means of a wick tied around it, which dips into a vessel of water. Owing to the evaporation from this bulb, its temperature is lower than that of the other, the difference depending upon the amount of moisture in the air. There is no real relation between the hygrometric readings and the actual state of the atmosphere, but the hygrometric state is deduced from reference to tables compiled from accurate observations with most elaborate instruments.

Hygroscope.—An instrument which indicates a change in the amount of moisture in the air, but generally incapable of giving exact measurements. The hygroscope usually depends upon the moisture absorbing property of such bodies as hair, catgut, etc.

Hyperbola.—A curve formed by a plane cutting a cone at any angle, with its base greater than that of its side. It is a curve, such that the difference of the distances from any point of it to two fixed points is equal to a given distance. The fixed points are called the *foci*.

Hyperbolic Logarithms.—In mathematics, those logarithms devised by John Speidell in 1619, of which the base is 2.7182818; also called Napierian logarithms, from the inventor of logarithmic tables.

Hypothenuse.—In geometry, the longest side of a right angled triangle, or the side opposite the right angle.

Hypothesis.—A supposition; something taken for granted, in order to draw a conclusion; something not known but assumed for the purpose of argument.

Hypsometer.—A thermometrical barometer for measuring altitudes. The temperature of boiling water is ascertained by means of a delicate thermometer, whence the atmospheric pressure may be deduced, and consequently the height.



I.—The ninth letter of the English alphabet. The dot we place over the small i, dates from the 14th Century only. As a numeral, I stands for one, II for two, etc. I and J were originally represented by the same character.

I Beam.—A rolled joist or beam resembling the capital letter I in cross section. Such beams are economical of material through elimination of redundant material near the neutral axis.

I. C. E.—An abbreviation for Institute of Civil Engineers.

Ice.—Water in its solid form; frozen water; it has a specific gravity of .920, and consequently occupies about $\frac{1}{8}$ more room than the water from which it was formed; this quality is taken advantage of for splitting rocks, etc. The latent heat of fusion of ice is 142.2 B. T. U.—i. e., it requires 142.2 heat units to melt one pound of ice at 32° F. to water at the same temperature.

Iceberg.—A detached floating mass or island of ice. A berg, as its name implies, is an *ice mountain*, flat detached masses are *floes*. The origin of icebergs is in the glaciers of the Arctic and Antarctic, which, gradually moving into the sea, break off into bergs, which are swept away by ocean currents into warmer latitudes. Owing to the specific gravity of ice, more than nine-tenths of the bulk of the iceberg is under water, about one-tenth being above the surface.

Ice Breaker.—A very heavy vessel especially designed for breaking ice as it forms in navigable waters, thus keeping a waterway open. The vessel is strongly reinforced at the bow, and is trimmed deeply by the stern; when driven forward, her weight rests upon the sheet of ice, and breaks it away where it is not shattered by the impact. Improved ice breakers have a forward propeller which creates a vacuum under the ice sheet, and so weakens it to resist the crushing strain of the ice breaker's bows.

Ice House.—A building, usually with its greater part underground, having non-conducting walls and roof, within which harvested ice is stored against the time of its requirement.

Ice Machine.—A machine for making ice artificially; as, by the production of a low temperature through the sudden expansion of a gas or vapor, or the rapid evaporation of a liquid.

Ice Making.—The art or process of manufacturing artificial ice, commonly by placing receptacles containing distilled water in a bath of brine, which is maintained at a temperature below 32° F., by mechanical refrigeration.

Ice Yacht.—A sailing craft used on frozen rivers and lakes; the hull consists of a platform or grating, mounted upon runners, like skates. The rear runner is pivoted and serves as a rudder wherewith to steer the craft.

Icosahedron.—A solid geometrical figure bounded by twenty equilateral triangles.

Id.—An abbreviation of a Latin word, *idem*—the same.

Idea.—A general notion or conception of one's mind, formed by observation and study.

Identical.—The same; the self-same thing; not different.

Idler.—1. In gearing, a tooth wheel occupying an intermediate position in a train, which communicates motion from the driver to the follower.

2. A pulley or drum which supports a belt or conveyer, or prevents it from coming into contact with a stationary part.

Idler Wheel.—In mechanical engineering, a wheel introduced into a train of gearing for the purpose of filling up a gap, or of changing the direction of motion without influencing the velocity ratio; called also *cock wheel*.

Igneous.—Caused by fire; a term applied to such rocks as lava, granite, quartz, etc., which were formed under the action of heat.

Ignite.—To take fire; to begin to burn.

Igniter.—A device, either portable or attached to a lamp or fire to light it; an electrical or other attachment to internal combustion engines for ignition of the charge.

Ignition.—1. The act of igniting, kindling, or setting on fire.

2. The state of being ignited or kindled.

Ignition Plug.—A screwed plug inserted into the cylinder wall or head of an explosive motor; it carries the ignition points, whether make and break, or jump spark, so that they may be easily removed for inspection, repair or renewal.

I. H. P.—Indicated horse power. The horse power developed within the cylinders of an engine as ascertained by the pressure recorded on an indicator diagram.

Illegibly.—In a manner not to be read; as, a letter written illegibly.

Illuminant.—That which affords light; as, gas, etc.

Illuminating Gas.—Hydrocarbon gas supplied through piping from a central source or place of manufacture, and whose flame is used for lighting purposes. It is generally obtained by means of the destructive distillation of bituminous coal in closed retorts, yielding a number of very complex hydrocarbons. Water gas is made by the decomposition of steam blown through red hot fuel, yielding hydrogen and carbon monoxide. The two processes are frequently used in conjunction, the coke or residue from coal gas manufacture furnishing the fuel for the water gas. Oil gas is made by spraying petroleum in heated retorts, converting the liquid into a fixed gas, burnt either by itself, or used to enrich coal or water gas. In certain places, natural gas, principally methane, issues from the earth and is used as an illuminant.

Illuminating Power.—Is the ratio of the amount of light emitted by a given source to the light emitted by a standard source. The standard candle, or unit of illumination, is a sperm candle consuming 120 grains of wax per hour, and the two lights are compared by a photometer.

Illumination.—That which gives light; brightness, splendor.

Illustrate.—To make clear, intelligible, or apprehensible; to elucidate; to explain; to exemplify; especially by means of figures, comparisons, examples, and the like.

Imbricated.—1. In building, bent and hollowed like a roof or gutter tile.

2. Lying over each other in regular order so as to break joints, like tiles and shingles.

Imitation.—That which is made or produced as a copy; that which is made to resemble something else.

Immersed Midship Section.—The area in square feet of the under water cross section of a ship amidships.

Immovable.—Incapable of being moved; firmly fixed.

Impact.—The sudden application or fall of a load upon an object or structure. A force acting with the effect of a blow.

Impair.—To grow worse; to deteriorate.

Impalpable.—Something very fine; that which cannot be felt.

Impel.—To drive or urge forward; impulse.

Impeller.—1. The disc or fan of a centrifugal pump.

2. The rotary part of a non-reciprocating engine; i.e., the "piston" of a rotary engine, corresponding to the *rotor* of a steam turbine.

Impenetrability.—1. The property of resisting penetration or perforation.

2. In physics, that property of matter which prevents two bodies from occupying the same space at the same time.

Impenetrable.—Incapable of being penetrated or pierced; not admitting the passage of other bodies.

Imperial Weights and Measures.—The standards used in England and her Colonies. The imperial gallon of Great Britain contains 277.463 cubic inches, or 1.2 U. S. gallons, or 10 pounds of pure water at 62° F.

Impinge.—To fall or dash against; to clash with.

Implement.—Whatever may supply a want; especially an instrument or utensil, as supplying a thing requisite to an end; as, an implement of industry.

Import.—To bring into a country from abroad.

Imports.—Manufactured goods and raw materials brought into a country from abroad.

Imposed Load.—In architecture, that load to which a structure is subjected, as distinguished from that due to its own weight.

Impost.—That which is imposed or levied; a tax, tribute, or duty; a duty or tax laid by a government on goods imported into a country.

Impounding Reservoir.—In hydraulics, a large reservoir where water supply from rivers may be taken in preparatory to filtering; the impounding reservoir is large enough to permit some preparatory settling.

Impregnation.—In civil engineering, timber for outside use is impregnated with various fluids or salts, to enable it to better resist the decomposing influences of the atmosphere, as is done with *creosoting*, etc.

Impression.—1. A mark produced upon any surface by pressure; as, of a stamp, copy or mould.

2. A print taken from type or an engraving.

Improper Fraction.—A fraction in which the numerator is greater than the denominator.

Improve.—1. To make better, to increase in worth, or efficiency; to advance in good qualities.

2. To develop the resources, appearance, or possibilities of any locality or country.

Improvement.—Advancement of anything from good to better; profitable use or application of anything; that by which the value of anything, especially property, is advanced.

Impulse.—1. The act of impelling, or driving onward with sudden force; impulsion; the action of a force so as to produce motion suddenly, or without appreciable lapse of time.

2. A term applied to the explosion of the gases which actuates the engine.

Impulse Turbine.—In hydraulics, a motor in which the fluid is directed by means of a series of nozzles, the vanes of which it drives.

Impulsive Load.—A load suddenly applied to a structure, subjecting it not only to the actual dead weight, but also to the accumulation of energy gathered in its motion. Also called *live load*.

Inboard.—Towards the center line of a ship; inside the line of a ship's hull; the opposite of *outboard*.

Inc., or Incorp.—An abbreviation for incorporated.

Incandescence.—White or glowing heat occasioned by a high temperature.

Incandescent.—Self luminous; emitting white light on account of high temperature; glowing because of heat.

Inch.—A measure of length, the twelfth part of a foot, commonly subdivided either decimally, as for scientific purposes, or into eighths, sixteenths, etc. It was also formerly divided into twelve parts, called *lines*, and originally into three parts, called *barleycorns*, its length being supposed to have been determined from three grains of barley placed end to end lengthwise.

Inch of Rain.—A unit used in the measurement of rainfall. In amount it is equal to 3630 cubic feet or 27155 gallons per acre.

Inch Pound.—In mechanics, a unit of calculation signifying one pound lifted one inch.

Inch Ton.—In mechanics, a unit of calculation denoting one ton lifted one inch.

Incineration.—The act of burning or reduction to ashes; consuming by fire.

Inclination.—A leaning; a direction or tendency from the true vertical or horizontal direction; as, the inclination of a column or a roadbed, especially on a railway.

Incline.—In mining, a shaft or adit at a considerable slope.

Inclined Plane.—A slope or flat surface inclined to the horizon, on which weights may be raised. By such substitution of a sloping path for a direct upward line of ascent, a given weight can be raised by a power less than itself. The simplest example we have of the application of the inclined plane is that of a plank being raised at the rear end of a cart for the purpose of rolling in heavy articles; as, barrels or hogsheads.

Inclinometer.—An instrument for measuring the rates of slopes or inclinations, by means of a spirit level and a graduated arc. A *clinometer* or *batter measure*.

Incombustible.—Not capable of being burned, or consumed; as, asbestos is an incombustible substance.

Income.—That gain which proceeds from labor, business or property of any kind.

Incompressibility.—In hydraulics, a property of liquids which is utilized for the transmission of power in hydraulic cranes, lifts, pistons, etc. The compressibility of water under the pressure of one atmosphere is from .00004 to .00005, decreasing with increase of temperature, an amount altogether inappreciable in practice.

Increase.—To become greater in bulk, quantity, number, degree, value, intensity; to grow.

Increase Twist Drill.—In tools for machinists, a twist drill in which the angle of the twisted groove increases as it recedes from the point in order to afford greater freedom of delivery to the abraded fragments.

Increasing Pitch.—In machinery, a screw is of increasing pitch when the distance between each blade, or rather between each successive turn of the helix, supposing the blades were thus prolonged, increases in amount; or the pitch may increase in the direction of the length of the blade from the center to the circumference.

Increment.—The act or process of increasing; growth in bulk, quantity, number, value or amount.

Incrust.—To cover with a crust, or with a hard coat; to form a crust on the surface of; as, iron incrustated with rust; a vessel incrustated with salt.

Incumbrance.—Anything that impedes motion or action, or renders it difficult or laborious; clog; impediment.

Indentures.—In law, the contract by which a youth is bound apprentice to a master and by which the master, in return for faithful service, agrees to teach the youth the arts and secrets of a trade. An *indenture* is a mutual agreement in writing.

Independent Chuck.—In machinery, a chuck in which each jaw is operated separately.

Independent Feed Lathe.—One having a back or feed shaft for the traverse as well as the leading screw for cutting threads.

Index.—A table of contents; a ready reference to topics, names, etc., in a book, usually alphabetical in arrangement and printed at the end of the book.

Index Plate.—A plate perforated with variously spaced holes, arranged in concentric circles, used in a milling or similar machine for dividing work, such as spacing out teeth in wheel cutting.

Index Wheel.—A circular wheel or disc graduated around its circumference for indicating the angular measurement through which it has been moved, as used on dividing engines, for testing, or for adjusting the feed on lathes.

India Ink.—More properly, *Chinese ink*. A black ink, sold in sticks, made from exceedingly fine lampblack, derived from the burning of certain oils, camphor, and camphor wood. The carbon is carefully dried and mixed with a parchment or fish glue to bind it into sticks, a little musk or camphor being added as perfume. This perfume is more or less an indication of quality. Liquid India inks are made of carbon derived from vegetable decoctions. Good India ink will not wash up, and, as it is free from acid, does not corrode the pens. A reliable test is to chip a little splinter off with a pen knife; the bright black fracture indicates good quality. Good Chinese inks are generally polished and gilded more or less.

India Rubber.—An elastic gummy substance derived from the milky juice of a variety of tropical trees and plants. The juice resembles cream as it issues from incisions made in the bark. It is coagulated by different methods, the South American plan being to "smoke" it. A wooden paddle is dipped in the semi-liquid rubber and the adhering film is dried by revolving the paddle over a smoky fire of twigs and branches. As soon as one coat is dry another is taken up, the process being continued until a large ball is formed. The best rubber, known as *Para*, comes from Brazil, Bolivia and Peru. Many other grades are obtained from South America and Africa, while successful attempts at cultivation have taken place in Ceylon, Straits Settlements, Mexico, etc.

Indicated Horse Power.—The measure of the work done within the cylinder of an engine.

Indicator.—An instrument by which the working steam records its working pressure, from which the power of the

engine may be calculated. It consists of a small cylinder communicating by a cock with the cylinder of the engine, and fitted with a piston, to which a pencil is attached. The roller upon which a card is fastened, is oscillated forward and backward by a cord attached to the piston rod of the engine. As the pencil rises by the steam pressure, and is brought back by a graduated spring when that pressure is reduced by expansion and condensation, a figure representing the pressure at each point in the stroke of the engine, is traced upon the card.

Indicator Card.—A figure drawn by the working steam of a steam engine, by means of an indicator. The diagram is shaped like a foot; its length represents the stroke, and its height the steam pressure in pounds. The average pressure, cylinder area, and piston speed are the elements for calculating the horse power.

Indicator Diagram.—In steam engineering, a diagram of work traced by the pencil of the indicator upon an indicator card. From it are deduced both the behavior and the mean effective pressure of the steam in the cylinder and thence the indicated horse power. To obtain the mean effective pressure, the area of the card is divided transversely by equidistant ordinates, ten or more as most convenient, perpendicular to the atmospheric line. Now, with a scale corresponding to the spring with which the diagram was taken, measure the pressure in the center of each of these divisions. The measurement being taken between the steam expansion and exhaust lines. The average of all the measurements will give the mean effective pressure.

Indicator Spring.—A device used in operating a steam engine indicator; it is the most vital part of the instrument, being used to show the varying pressure of the steam in the engine cylinder.

Indicator Wheel.—In a grain elevator a spoked wheel, by means of which a revolving spout or turn head of an elevator is moved through any desired angle and held there. When the wheel is fixed on a stand, and the spout rotated by a rod whose handle locks in the wheel, the latter is termed an *indicator ring*.

Indigo.—A substance obtained as blue powder from certain Indian plants, by bruising and fermenting in vats of water in which the dye is deposited. The powder is pressed into cakes and dried. The dye is insoluble in water, alcohol and ether, oils or acids; but is dissolved in lime solutions to which are added certain deoxidizing agents, such as copperas or powdered zinc. The indigo absorbs hydrogen liberated from the decomposed water, and dissolves into a yellow liquid, known as white indigo. Articles dipped into this vat for fifteen minutes are dyed *white*, but on exposure to the air for five minutes, turn green and then blue, owing to the re-oxidizing of the indigo. The number of "dips" varies according to the depth of color required.

Indium.—A soft white metal, belonging to the same group as *aluminum*.

Induced Draught.—An artificial draught operated by suction through the flues, etc., as opposed to forced draught.

Induration.—The quality or state of growing or becoming very hard, either through heat or great dryness; as, the *induration* of clay or soil.

Industry.—Any department or branch of art, occupation or business; especially one which employs much labor and capital, and is a distinct branch of trade; as, the iron *industry*; the cotton *industry*.

Inelastic.—Rigid, inflexible; unable to return or assume its original condition or shape, after a strain. In a scientific sense, all bodies possess elasticity, its amount or degree alone varying.

Inertia.—That property of matter by which it tends, when it rests, to remain so, and when in motion to continue in motion, and in the same straight line or direction, unless acted on by some external force; sometimes called *vis inertiae*.

Inflate.—To swell or distend with air or gas; to enlarge; as, to inflate a bladder or balloon.

Inflow.—To flow in.

Infringement.—An encroachment or intrusion; a breach of right, law or obligation; as, the infringement of a patent.

Infusion.—1. The act or process of steeping, so as to extract the principles or qualities of a vegetable substance. The term indicates the use of hot water, etc., but not boiling.

2. The liquid essence or extract obtained by steeping or soaking.

Ingate.—In founding, the pouring gate of a mould.

Ingot.—1. An oblong block into which such metals as, gold, silver, copper, tin or alloys, are cast after purification. Such blocks usually bear the finer's or foundry stamp and are ready for remelting.

2. A slightly conical, hexagonal or cylindrical mass into which steel is cast before it is forged or rolled. The ingot moulds are usually of cast iron, of great thickness and accurately fitted. After pouring, as soon as the steel is set, the cotters are knocked out of the mould and the red hot mass taken by the crane from the mould and placed in the soaking pits to anneal or reheat.

Ingot Mould.—In metallurgy, the mould in which ingots are cast, varying from the small branded moulds for copper and brass, to the large and massive moulds made for casting steel ingots. These last are conical in form, used for the casting of the steel from the ladle or converter before it is passed on to the rolling mill.

Ingot Steel.—A term applied to mild steel produced by the Bessemer or open hearth process, as it is cast into the form of ingots, preparatory to further treatment.

Ingrain.—Dyed before manufacture; said of the material of a textile fabric; hence, in general, thoroughly inwrought; forming an essential part of the substance.

Ingredient.—That which enters into a compound, or is a component part of any compound or mixture; an element.

Inhaul.—A rope used to draw in the jib boom or flying jib boom.

Initial.—That which begins anything, or the state of any given thing at the commencement of an operation.

Initial Condensation.—The steam condensed by contact with the metallic surfaces of cylinder walls, cover and piston, immediately upon entering.

Initial Pressure.—The pressure on the piston at the beginning of the stroke, of a steam, gas or other heat engine, which is the same as the boiler pressure, less loss through friction in piping and passages, or the pressure due to explosion, in gas engines.

Initial Temperature.—The temperature of any fluid, at the beginning of a cycle of operations or the like; as, of steam entering a cylinder from the boiler.

Initial Velocity.—The speed with which an object is originally endowed; or the velocity at which it is already moving, when modifying forces begin to act upon it.

Injection.—The act of injecting or throwing in; applied particularly to the forcible throwing in of a liquid, or aeriform body, by means of a pump. A term used to denote the water supply of a jet condenser.

Injector.—A boiler feeding device, in which the momentum of a steam jet, directed by a series of suitably disposed conical nozzles, carries a stream of water into the boiler; the steam condensing within and heating the water which it forces along. The action of an injector is due to the fact that the velocity of a jet of steam flowing from a nozzle is much greater than water flowing under the same conditions.

Inking In.—The process of completing a mechanical drawing by going over the finished pencil work with a pen, using India ink, this being necessary for the preservation as well as the neat appearance of the work.

Inlaying.—The art or process of inserting strips or pieces of beautiful woods, mother-of-pearl, etc., into suitable recesses on the surface of cabinet work, for the sake of ornamentation. Steel weapons are also frequently inlaid with gold or silver, let into small pits or grooves, forming ornamental patterns on their surface.

Inlet.—A passage or opening, through which an enclosed part may be entered; an entrance, means of ingress, or place of admission.

In Line.—A shop term, to signify that the work is in the same center or in the same plane. To get several distant points in line, measurement is taken from a known level surface.

Inner Square.—In carpentry, the angle formed by the inner edges of a carpenter's square.

Inner Tube.—In an automobile, a soft air tight tube of nearly pure rubber which fills up and fits within the outer casing.

Ins.—An abbreviation for Inspector and Insurance.

Inscribe.—To draw a figure within another; as, a triangle within a circle, in such manner that the points of the former just touch the circumference of the latter.

Insert.—To bring into; to introduce; to set within something; to put or thrust in.

Inserted Joint.—In well boring, a term applied to the screwed joints of tubing, where there is no separate coupling, but one end of the tube is screwed down for the male end, and the other is swaged out to form the female connection.

Inserted Tooth.—1. A separate saw tooth, a series of them being placed in sockets around the circumference of a circular plate, thus facilitating repairs, replacement, and permitting the use of harder cutting edges.

2. A wooden cog fitted into gearing. Pairs of toothed wheels are frequently employed in millwrighting, where a silent drive is desirable, in which the driving wheel has its teeth composed of apple wood or hornbeam, the follower having ordinary iron teeth.

Inserted Tooth Cutter.—In machinery, a cutter in which the teeth are separately inserted in a disc or head.

Insertion.—In mechanics, sheets of elastic material used to make joints between flanges of pipes, etc., consisting usually of india rubber, with canvas or duck inserted.

Insertion Sheet.—In steam engineering, a thin sheeting composed of india rubber and brass wire, used for making steam joints.

Inset.—In moulding, the same as gate.

Inside Admission.—In a steam engine, a reversal of the usual methods, generally followed with piston valves, in admitting steam through the central cavity on the cylinder face, the lap being provided on the inner edges of the valve, while steam is exhausted past the outer edges into the valve chest. This prevents high pressure steam from coming into contact with the valve spindle glands, and materially shortens the steam passage from a high pressure to its intermediate cylinder.

Inside Calipers.—Those with straight legs, curved slightly outwards at the toe, used to measure the diameter of bored holes, etc.

Inside Chaser.—In lathes, a chasing comb for cutting or shaping internal or female screw threads.

Inside Clearance.—In a steam engine, a term occasionally used for the minus exhaust lap given to certain slide valves, where the exhaust edges are pared away to give freer passage to the waste steam and reduce back pressure. The employment of this term is to be reprehended as it is liable to occasion confusion with *clearance* of the piston, an entirely different matter.

Inside Cylinders.—In a locomotive, are placed between the frames, thus necessitating the use of a crank axle. The inside position is held to keep the temperature of the cylinders nearer uniform—thus minimizing condensation, and the lateral motion of the engine is undoubtedly less than with outside cylinders, on account of the crank centers being so much closer together.

Inside Gouge.—In shop work, a *paring* gouge, so called, because it is ground on the inside or hollow face.

Inside Jaw.—In machine work, the jaw of a lathe chuck which is inside of the work which it clips.

Inside Lap.—In a common slide valve, the amount by which the edges of the exhaust cavity overlap the inside edges of the steam port when the valve occupies its central position. As outside or steam lap cuts off the supply of steam before the completion of the stroke, in like manner inside or exhaust lap, opens the valve to release later, and cuts off the exhaust earlier, thus increasing compression.

Inspecting Pits.—On railways, pits sunk between the rails in roundhouses, and car sheds to facilitate inspection and repairs of the underneath portions of locomotives and cars.

Inspection.—A close or careful scrutiny; investigation.

Inspector.—One who inspects, views, or oversees.

Inspirator.—A lifting and forcing injector, in which two distinct sets of steam and water cones are combined within one body, one set for lifting and one for forcing.

Inst.—Abbreviation for instant, the present month.

Installation.—1. The erecting or putting in place of machinery or apparatus for future use.

2. The assemblage of machinery, apparatus, etc., so set up; a plant which is put up in a more or less permanent manner.

Installment.—One of the portions of a whole which have to be paid or delivered at various periods, usually at successive stated intervals, as with monetary transactions or consignments of merchandise.

Instantaneous.—1. Done in an instant; moving or acting without perceptible lapse of time.

2. At or pertaining to a given instant of time; as, *instantaneous* position.

Institute.—An institution; a society established for the promotion of learning, philosophy, art, science, etc.

Instroke.—In gas engines, the reverse of an *outstroke* or the return stroke of the piston in a direction towards the ignition chamber.

Instruction.—The act of instructing, teaching, or furnishing with knowledge; information.

2. That which instructs, or with which one is instructed; teaching.

Instructor.—One who instructs; a teacher; a person who imparts knowledge to another.

Instrument.—That by which work is performed, or anything is effected; a tool; a utensil; an implement; as, the instruments of a mechanic, astronomical instruments, and the like.

Instrumental Arithmetic.—Mathematical results obtained by simple inspection of instruments instead of by elaborate calculations. The *slide rule*, the *sector* and the various computing scales are aids in instrumental arithmetic.

Insulation.—1. In steam engineering, the separation of steam heated surfaces from the cooling effects of outside air for the purpose of economy, etc.

2. A name given to boiler coverings, and *steam jackets*.

Insulating Paper.—A paper used largely in covering steam pipes and steam surfaces to prevent the loss of heat, or on woodwork to protect it; also to prevent air currents through the walls of buildings.

Insurance.—The act of insuring, or assuring against loss or damage; a contract whereby, for a stipulated consideration, called a premium, one party undertakes to indemnify the other against loss by certain risks.

Intact.—Left untouched, whole, unharmed; neither defaced nor injured.

Intaglio.—A figure cut into something; as, a gem, so as to make a design depressed below the surface of the material; opposed to *cameo*.

Intake.—1. In a waterworks, the pipe by means of which water is drawn off from a reservoir into the main.

2. In an explosion engine, the inlet pipe between the *carburetor* and the cylinder which conducts the mixture to the cylinder.

Integer.—In mathematics, a whole number; in contradistinction to a fraction or a mixed number.

Integral Calculus.—In higher mathematics, a method of calculating or investigating by algebraic symbols, especially that branch of analysis which investigates infinitesimal changes of quantities, when the relations between the quantities are given.

Integrator.—In mathematics, a calculating machine for integrating or computing wholes from a number of parts or the like. A term usually applied to *tide computing machines*, although *planimeters*, etc., are also integrators.

Intense.—Extreme in degree; fervent: said of heat; severe; violent.

Intensifier.—In hydraulics, a device frequently employed in place of the hydraulic accumulator, for converting a low pressure into a higher. The water at low pressure operates a piston in a large cylinder, which in turn operates a ram of smaller diameter in a smaller cylinder. The areas of the two cylinders are proportional to the difference in the low and high pressure required.

Intensifying.—1. The act or process of increasing the energy, capability, or effect of anything.

2. The property of adding to the energy with which anything operates, or to its effectiveness as measured by results.

Intercepting Valve.—A combination valve, fitted to compound locomotives, which deflects the exhaust from the high pressure cylinder into the stack, and admits, when desired, live steam to the low pressure. It is used for starting purposes, or to work the engine as non compound, if necessary.

Interceptor.—In steam engineering, a T shaped, cylindrical vessel employed in connection with engines to prevent particles of water from being carried over with steam into the cylinders. The steam in its passage through the interceptor meets with a diaphragm plate by which the water is thrown down, to be subsequently drained off by a small cock. Also called *separator*.

Interchangeable.—1. Capable of interchange.

2. Permitting transposition.

3. To put each (of two things) in the place of the other.

4. In manufacturing, the ability of each similar piece to fit where every other similar

piece will fit: as, in laying up a wall the brick-layer takes up any brick nearest to his hand, well knowing that it will lap over his two bricks already laid, as well as any other. When a line of water pipe is to be laid, the castings are dropped indiscriminately along the road, with full assurance that one end of each will fit into the end of the preceding one. In a watch factory, all the screws of the same style and the same nominal size will fit into the same place in the watch.

Interchangeable Gearing.—In mechanical engineering, this term denotes gears whose teeth are so designed that wheels of any number of teeth, if of the same pitch, will gear together correctly. This can only be secured by designing the teeth on a common basis.

Intercooler.—In refrigeration, a species of surface condenser or economizer, between the two stages of a compound air compressor, so that the heat of compression liberated in the first cylinder may be removed from the air as it passes to the second or high pressure compressing cylinder. The cooling surface usually consists of nests of small brass or copper tubes through which water circulates.

Intercostal.—In ships, a side keelson fitted in between the floors or ribs, and attached to them by angles.

Interest.—An allowance paid for the use of money, the sum on which it is paid being termed the *principal*. The interest is usually specified as a percentage of the principal, and may be either *simple*, as interest upon principal only, or *compound*, which is interest upon principal and also on the interest as it accumulates.

Interheater.—In a steam engine, an apparatus acting as an intermediate receiver between the high and low pressure cylinders. The interheater is traversed by tubes carrying high pressure steam, which slightly superheat the exhaust from the high pressure, preventing initial condensation in the low pressure engine. Also called *superheating receiver*.

Interior.—The internal part of a thing; the inside; as, the interior surface of a hollow cylinder.

Interlocking.—In a railway, the combination of a series of semaphore and point levers one with another by means of latches, etc., so that only the proper combinations may be used; thus at a junction the levers are so interlocked, that the branch signal cannot be lowered until the points are properly set, and while the branch signal and points are set, the main line signal cannot be lowered.

Intermediate.—Occupying a middle position between two extremes; intervening in a series.

Intermediate Cylinder.—In a triple expansion steam engine, the second cylinder in which the steam is expanded. In quadruple engines there are two intermediate cylinders, first and second.

Intermediate Motion.—In agricultural machinery, separate gearing introduced between a horse power gear and the machine to increase speed.

Intermediate Receiver.—In steam engineering, a vessel or casing employed on some compound engines; as, a steam chamber or *reservoir* between the high and low pressure cylinder. It is made necessary when the cranks of the two cylinders are set at right angles with each other, so that when one piston is at full, the other is at mid stroke. Its effect is also to equalize the back pressure in the high pressure cylinder and to diminish the variations in its temperature.

Intermediate Shaft.—In mechanical engineering, a shaft placed between *first* and *third* motion gearing, acting as a carrier of motion between the two, with or without change of power.

Intermediate Spindle.—In cotton spinning, a twisting spindle which is used on the intermediate processes of drawing the rovings into yarn.

Intermediate Tap.—A tap for forming internal screw threads, which follows the taper tap in tapping by hand. It is cylindrical except at the end, where it is tapered off to the size of the tapping hole, and thus cannot serve for holes, which have to be tapped to the bottom. Also known as *second tap*.

Intermediate Wheels.—Idler wheels in a train of gearing. Those wheels in a screw cutting lathe running on a stud upon the change wheel quadrant, which transmit motion from the mandrel to the leading screw; the intermediate wheels are also those through which compounding may be obtained.

Intermix.—To mix together; to be intermingled.

Internal.—1. Inward, interior, as opposed to external or outward.

2. That which is enclosed within limits or takes place within definite bounds.

3. Domestic or native as contrasted with foreign or colonial.

Internal Combustion Engine.—A heat engine deriving its power from the energy liberated by the explosion of a mixture of some hydrocarbon, in gaseous or vaporized form, with atmospheric air. The combustion of the mixture evolves great heat, dilates the gases, and so creates pressure which is applied to a piston as in a steam engine.

Internal Cylinder Gauge.—In railway engineering, an accurately made solid steel cylinder, used as a standard of measurement of cylinder holes.

Internal Feed Pipe.—A pipe perforated at the end, leading the feed water from the check valve opening through the hotter portions of the boiler to the coldest, thus assisting circulation, and gradually introducing the feed water without shock.

Internal Fired Boiler.—In steam engineering, a boiler whose fuel is burnt in a flue or flues within the boiler itself. The marine return flue boiler and the locomotive and portable, with internal tubes, and the vertical, with uptake and cross tubes or field tubes, are internally fired boilers.

Internal Flange.—In structural iron work, a flange running around the inner diameter of a pipe or cylinder. Used on foundation and other large cylinders and pipes.

Internal Flue.—In steam engineering, the flue of an internally fired boiler, which is therefore enclosed within the shell. Example occurs in *marine boilers*.

Internal Forces.—In mechanics, forces which act between the different parts of a body or systems of bodies taken as a whole. These, therefore, are distinguished from *external forces* and produce stresses.

Internal Gear.—In mechanical engineering a gear in which the teeth project *inward* from the rim, instead of *outward*.

Internal Gear Wheel.—A cog wheel whose teeth are within the rim, the points being inside and the flanks outside the pitch circle; the pinion operating within the wheel. Also termed *annular gear*.

Internal Pressure.—In a steam boiler, the force with which the confined steam presses against the boiler walls which

produces a tensile stress in the shell. In the circumferential direction, this stress, per square inch of metal, is equal to one-half the diameter of the shell multiplied by the pressure in pounds per square inch. The intensity of longitudinal stress is only half as great as that in the circumferential direction. In a *spherical* shell the stress is only half as great as in a *cylindrical* shell taken under similar conditions of diameter, thickness and pressure.

Internal Screw Gauge.—In mechanics, a solid steel cylinder with a screw thread on it for testing the diameter of female screws.

Internal Strain.—To stretch from within; as the pressure of steam within a boiler; extending outward with great force.

Internal Stress.—Initial stresses set up in the interior portions of castings, forgings, etc., by conditions of manufacture. Large castings are often hide-bound by unequal cooling or too rapid shrinkage of the outside; in ordnance, such stresses are deliberately set up by winding wire, at high tension, round the central tube; this tends to compress the latter, thus largely neutralizing the expanding force of the discharge.

Intersection.—1. The act of cutting or crossing; as, two lines meeting in the same plane.

2. The point where two lines cut or cross each other.

Interstice.—That which intervenes between one thing and another; especially, an empty space between things closely set, or the parts which compose a body; a hole; an interval.

Interval.—A space between things; a void space intervening between two objects.

Intorsion.—A winding, bending or twisting.

Intrados.—In civil engineering, the interior or under surface of an arch.

Intrusive.—Geologically, igneous rocks that have been forced, in a molten state, into fissures and openings of the sedimentary or stratified rocks during seismic disturbance.

Invention.—Something originated or found out; a discovery; a novel device or method; a contrivance, plan or scheme embodying new and original ideas.

Inventory.—A list of the property belonging to a person or plant; any catalogue of tools and materials.

Inverse.—Opposite in order; reversed; opposed to direct.

Inverse Ratio.—That formed by inverting the terms of a given ratio; thus, 8 : 9 is the inverse of 9 : 8.

Invert.—An inverted arch; the lower portions of tunnels or sewers are so termed from their shape. In tunnels through firm strata without great pressure, the lower third of the ellipse is omitted, but the name is still retained for the floor.

Inverted Arch.—An arch whose crown is turned downwards, the keystone thus being its lowest point. It is used in foundations, in the floors of tunnels, etc., where it is necessary to sustain great pressure. An inverted arch is employed underneath large openings in the walls of buildings, to prevent deformation of the pillars under the side thrust.

Inverted Cone.—In hydraulics, a term applied to the shape described by the subterranean water courses in flowing to a well. This effect is produced by heavy pumping, which tends to maintain the water in the well at a point greatly below its normal level.

Inverted Cup Valve.—An inversion of the hydraulic valve used in gas works. The body is made to resemble a T head or separator, with a central vertical diaphragm extending part of the way down, the lower end of the separator or T being surrounded by a cup filled with quick-silver or other heavy fluid. When the cup is lowered, a passage is opened underneath the central diaphragm, but when the cup is raised the mercury, etc., fills the lower part of the chamber and seals the opening.

Inverted Syphon.—In hydraulics, a conduit, shaped like a gigantic U, by means of which water mains are carried underneath rivers, etc., the water rising as high on the further shore as on the other, owing to a fundamental principle of hydrostatics.

Invisibility.—That which is invisible; as, dry steam.

Invoice.—A written account of goods; as, machinery or supplies, sold or shipped, with prices and other particulars.

Involute.—In geometry, if a cord, wrapped around a curved surface, be unwound under tension, its free end will describe a curve which is the *involute* of the first. The original curve is the *evolute* of the second.

Involute Curve.—In geometry, the curve which is described by the end of a cord uncoiling from another curve. The curve traced by a cord unwinding from a circle is the *involute of the circle*.

Involute Teeth.—Cogs whose curves are formed by the involutes of a circle, the root and the point of such teeth forming one continuous curve. This gives these teeth the property of working smoothly with each other if the distance between the wheel centers be varied, which is a necessary point in rolling mills and the like where the axes of the wheels are apt to approach or recede from one another.

Involution.—The raising of a number (called the root) to any power. The powers of a number are its square, cube, 4th power, 5th power, etc.

$2 \times 2 = 4$	4 is the square or 2nd power of 2.
$2 \times 2 \times 2 = 8$	8 is the cube or 3rd power of 2.
$2 \times 2 \times 2 \times 2 = 16$	16 is the 4th power of 2.

Inward Flow Turbine.—In hydraulics, a water motor consisting essentially of two horizontal rings of buckets, one ring being enclosed within the other, and its buckets or *chutes* becoming the guides to a column of water, which having descended by gravity under a definite head, is caused to impinge on the buckets of the inner ring and to turn it by reaction.

Iodoform.—A body consisting of shining yellow scales, insoluble in water but soluble in ether, alcohol and chloroform. It is prepared by warming together sodium carbonate, alcohol, water and iodine, and is used as an antiseptic and disinfectant for wounds and sores; its action being probably due to the liberation of iodine. Its smell is characteristic and penetrating.

-ion.—A suffix denoting act, process, result of an act or process, thing acted on, state or condition, as construction, dominion, etc.

I.O.U.—An abbreviation for *I owe you*.

Iridescent.—Prismatic; exhibiting a play of colors like those of the rainbow.

Iron.—One of the metallic elements. Of all metals, none plays so important a part in civilizing, mechanical advance, etc., as iron; it is obtained from ores in which it is combined with earthy or stony substances and frequently with carbon, phosphorus, sulphur, arsenic, magnesia, etc.; iron is never found in its native condition, chemically pure, nor is any iron manufactured in a large way found to be free from impurities. Iron is put upon the market in three forms: (1) cast iron; (2) wrought iron; (3) steel. Different names are given to iron as needed to describe its size, form, quality or use; thus: gossamer iron (sponge iron), hoop, band, scroll, tee, groove, plate, bar, angle, flat, rod, sheet, hexagon, galvanized, horse shoe, nailrod and scrap iron.

Iron Borings.—The borings from machine shops which are preserved and used for the calking of water tight joints, surfaces, etc.

Iron Cement.—1. In steam engineering, the material used for making *rust joints*. It consists of iron borings, passed through a $\frac{1}{4}$ or $\frac{1}{2}$ sieve, mixed with sal ammoniac and dampened. Sulphur is sometimes added.

2. For ornamental iron work, iron cement is made of iron borings of the finest qualities and mixed with white lead and linseed oil. Used in *putting up* sidewalk vaults, skylights, etc.

Ironing Machine.—A laundry machine, in which an internally heated iron roller works against rollers clothed with flannel or other textile material, the clothes to be laundered being passed between the rolls. The ironing cylinder may be heated by steam or by an internal gas flame; the clothed rollers are open ended shells, clothed with vulcanized rubber and outer layers of Canton flannel and muslin.

Iron Oxide.—In chemistry, a mixture of two elements, formed of *oxygen* and *iron*, producing slow combustion.

Iron Oxide Paint.—In a foundry, paint used as a protective coating for castings prepared from an iron oxide earth and linseed oil. It is cheaper than lead paints, while its affinity for iron renders it more suitable as a protection for that metal than the ordinary lead paints.

Iron Pyrites.—A natural metallic sulphide of iron, utilized in the manufacture of sulphuric acid, sulphate of iron and alum. It is sometimes mistaken for gold, but may be distinguished by its hardness and brittleness.

Ironstone.—Two iron ores are known by this name, one consisting of a sort of brown sandstone, strongly impregnated with iron; the other, more generally known as *clay ironstone*, or spathic iron ore, an impure ferrous carbonate mixed with clay. This ore, while constituting a large and valuable source of iron, furnishes a slag which is admixed with other clay to form ironstone china.

Ironstone China.—A hard white pottery in which is incorporated the ground slag of clay ironstone. The name is also applied to hard durable earthenware, such as is used on shipboard.

Ironwood.—A name applied to different woods, in various parts of the world, which are noted for hard texture and great weight. The ironwood, known to the timber trades, comes from South and East Africa (black or white ironwood), the latter being yellowish to red brown in color. East Indian ironwood is of mahogany color and a coarse tough grain.

Iron Work.—In building, a general term for those portions of a structure, vessel, carriage, or the like, which are made of iron. In general usage, the term still holds, although mild steel has replaced iron to a great extent.

Irrigation.—1. The act of moistening or supplying with moisture.

2. In agriculture, the supplying of land with water by means of channels and ditches, either admitted through sluices from rivers at high water, by means of pumps, or water lifts from streams at a low level, or else by canals from a distance.

Irrigation Canals.—Waterways constructed for the purpose of conveying and distributing water over dry and rainless regions.

I Section.—In building, a rolled I beam.

Isinglass.—1. A substance prepared from the bladders of the sturgeon.

2. Sheets of mica, popularly so called.

Island Platform.—A platform at a railway station, having a track on either side of it, the one platform serving for trains in either direction.

Iso.—A word derived from a Greek word, meaning *equal*, used in combination with a great number of words; as, *isodynamic*, *isothermal*, etc.

Isobar.—A line of equal pressure on an indicator diagram such as is represented by the horizontal admission line.

Isobaric Surface.—A surface in the air, all points of which have the same barometrical pressure.

Isochromatic.—Of the same color or tint; of uniform color throughout.

Isochronous.—Having equal times. The term is applied to uniform motion, as with an isochronous governor, whose pendulum, traveling in the path of a cycloid, performs its revolutions or beats in uniform time, whether the arc be large or small; also to two or three motions which occur in the same time, as of two pendulums swinging exactly in time with each other.

Isochronous Governor.—A governor which is very steady at one fixed speed, but which requires only a slight variation in speed, to make the arms fly up or down, according, as the speed increases or lessens. This is effected by placing a cross piece upon the governor spindle, the two ball arms being hinged to this piece in a crosswise manner, so that the ball is on the opposite side

of the spindle to its pin. Care needs to be taken in designing such a governor that it is not oversensitive.

Isometric Projection.—A method of perspective drawing, employed in delineating mechanical objects. It enables three sides to be seen at one view, being a projection on lines equally inclined to the three principal axes of the object delineated, the angles remaining the same as in plane drawing.

Isopleric Cycle.—A cycle of operations at a constant volume.

Isosceles Triangle.—In geometry, a triangle having two equal and opposite sides.

Isothermæ.—Shown in an indicator diagram, as applied to an expansion curve, means that such a curve represents the expansion or compression of the steam when the temperature is uniform.

Isothermal.—1. In physics, signifying that change of pressure or volume takes place without change of heat; as, isothermal expansion means expansion without gain or loss of heat.

2. In meteorology, pertaining to an *isotherm* or imaginary line connecting places which have equal temperatures.

Isothermal Compression.—A term used when a gas is compressed without change of temperature, through heat being taken away.

Isothermal Expansion.—Takes place when a gas expands while its temperature remains constant, heat being added. The opposite of isothermal compression.

Isothermal Lines.—In physics, lines of equal temperature, as opposed to adiabatic curves. Isothermal lines are those produced on diagrams of work under varying pressure with constant temperature.

Isotropic.—A term applied to bodies whose elastic forces are alike in all directions.

Ivory.—A hard, white, fine-grained substance, whose chief source is the tusks of the elephant and his fossil predecessors. It is a most important and valuable article of commerce.

Ivory Black.—A pigment obtained by burning ivory chips to charcoal, like *boneblack* or *animal charcoal*.



J.—The tenth letter in the English alphabet. I, i, J and j were treated as the same letter in alphabetic arrangements until about the year 1800.

Jab.—A sharp thrust or poke; a punch.

Jack.—1. A lifting jack, either screw, gearing or hydraulic, by means of which a small force, exerted through a comparatively long period, is able to overcome a great resistance. In mining, a wooden wedge for bringing down masses; as, coal, etc.

2. A small square flag or ensign, shown at the bow of a ship; also a term applied to various appliances; as, jack screw, jack plane, etc.

Jack Engine.—In coal mining, etc., a donkey engine.

Jacket.—1. A covering for a steam cylinder, pipe or the like, to prevent the escape of heat.

2. A term applied to the clothing plate of Russia iron, or thin sheet steel, used to cover and hold in place the lagging or clothing of a boiler.

Jacketed Cylinder.—A steam engine cylinder provided with a jacket or annular space between its double walls, which is filled with high pressure steam to save heat.

Jacket Water Circulation.—In internal combustion engines, circulation of water through the jacket or annulus formed between the cylinder lines and barrel, to remove excess of heat developed.

Jack in a Box.—1. A device for holding a planer tool in position while the carriage moves.

2. A screw jack for raising and stowing cargo.

3. In thieves' lingo, a tool resembling a screw jack, used in breaking into safes.

4. A form of differential gearing, by means of nested bevel wheels, mounted on the rear or driving axles of an automobile, so that one wheel may revolve at a different rate to the other when going around a curve. Also called *differential gear*.

Jacking Machine.—A machine for imparting a pebbled appearance to leather.

Jack Knife.—1. A large strong clasp knife for the pocket.

2. A horn handled clasp knife with a lanyard, worn by seamen.

Jack Plane.—A medium sized carpenters' tool for smoothing boards or other surfaces of wood, forming mouldings, and the like, consisting of a stock, usually of wood, from the under side, face or sole of which projects slightly, the steel cutting edge of the iron, or chisel, which inclines backward and has an aperture in front for the escape of shavings.

Jack Rafter.—A short rafter which does not extend to the ridge of the roof, as in the hips.

Jack Screw.—A device for raising heavy weights, in which the power of the screw is applied. Jack screws are carried on all locomotives for use in re-railing if they should be thrown from the track.

Jack Shaft.—In an automobile, the countershaft or second motion shaft, driven by the change speed gear, and which in turn drives the wheels by chains.

Jack Staff.—In a ship, the pole from which the jack is flown.

Jack Stay.—A nearly horizontal stay between the main and fore mastheads of a steamship, mutually supporting them over the funnels.

Jack Timber.—In carpentry, a timber in a building which is shorter than the other timbers, being intercepted by another piece; as, a studding in a partition, which is intercepted by a brace or a window or door frame, a rafter in a hip roof, which meets the hip and is shorter than those which run to a full length and meet at the comb or ridge. A rib in vaulting or groining, shorter than the main rib.

Jack Wood.—A valuable wood of the jack tree used by cabinet makers and carpenters.

Jacob's Ladder.—A rope ladder with wooden rungs or treads, to give access to a ship's deck from small boats.

Jacquard.—So named from the inventor, Jacquard of Lyons.—A contrivance attached to a loom for weaving figured goods; as, of silk or cotton, and also for weaving carpets. It consists essentially of a series of perforated cards or of perforations in paper or metal, connected with a revolving perforated prism, and so arranged as to secure the raising of the proper warp threads to produce a figure of a given pattern by the entrance of wires connected with these threads into particular perforations.

Jag.—In machinist work, a roughed up, barbed, or projecting portion of metal produced by *nick*ing underneath, or in front of it, with a cold chisel, or with a smiths' chisel, or by casting.

Jag Bolt.—In machinery, a tail bolt whose shank or tail is roughed up by jagg^{ing}.

Jagger.—In stone cutting, a toothed chisel.

Jagging.—In a foundry, when a wrought iron bar, a shaft, or an eye is to be cast into a piece of work, the portion which is embraced by the casting is *serrated* or *notched* in order to prevent it from being pulled out subsequently. The serration is called *jagging*.

Jag Spike.—A long spike having indentations giving it barbed or ragged edges to secure a better grip or holding power.

Jam.—To hold or lock anything immovably by forcing something else against it. To grip or enclose anything so that it is incapable of motion.

Jamb.—The upright or vertical side of an aperture; as, of a door, window or fireplace, which supports the lintel, mantel-piece or entablature.

Jamb Brick.—One shaped suitably to form part of the side of a window or door opening.

Jamb Stone.—A vertical stone or pillar on either side of a door or window opening.

Jamming.—In steam engineering, the sticking of cocks and safety valves in their seatings, due to a wedging action induced by various circumstances. Safety valves jam by reason of corrosion or distortion, cocks through too slight an angle being given to their plugs, and also from corrosion.

Jam Nut.—A nut, placed in contact with the main nut on the same bolt, to keep the main nut from turning.

Jan.—Abbreviation for January.

Japanning.—Enameling applied to a variety of articles, chiefly those made from tin plate. Japan is a varnish made usually with copal and colored with mineral pigments; the commonest color, black, is due to asphaltum. After varnishing, the articles are *stoved*; that is, dried in heated chambers, the temperature often attaining 300° F. Several coats are applied to good work, each being stoved before the next is put on. This results in a durable thick coat.

Japan Wax.—A wax like material used in the manufacture of polishes. It is a solid fat obtained from the fruits of certain Japanese trees, and consists chiefly of palmitine.

Jar.—1. A vessel, as of earth or glass, with a large body and broad mouth.

2. To give forth a harsh or discordant sound; as, a jarring voice.

3. To cause to tremble or shake; as, by a shock or blow; jolt; agitate; as, the machinery *jars* the building.

Jars.—In well boring, a connection between the sinker bars, and the poles or cables, made in the form of two links, having a slide on each other of about two feet. The jars permit the tools to fall on the downward stroke, but on the upward jar them, or give them a sharp pull, tending to loosen them from any crevices or cavings that may hold them; a drill jar.

Javel.—To soil with dirt; to bemire.

Jaw.—1. A grasping tool having jaws; as, a monkey wrench.

2. One of a pair of members between which a piece of material is held, crushed or cut; as, the jaws of a vise.

Jaw Clutch.—A positive connection for engaging or disengaging parts similarly to a friction clutch.

Jaw Crusher.—A machine for breaking up stone, ore or similar materials, between its two jaws, one of which is moved relatively to the other by means of a toggle joint or eccentric.

Jaws.—Two opposing parts of a mechanism, capable of being moved towards each other for the purpose of gripping, holding or crushing anything placed between them.

Jemmy.—A crowbar of varying length; a burglar's implement often made in section, to avoid detection. Also spelled jimmy.

Jenny.—1. In machinery, the traveling frame which carries the chain sheaves upon the horizontal jib of a crane. It is traveled or racked along the jib by racking gear.

2. In manufacture, a form of spinning machine invented by Jacob Hargreaves.

Jerk.—A short, sharp, pull or twitch; a smart blow.

Jerking Plant.—A system whereby a number of petroleum wells are connected to one central pumping engine by means of an ingenious adaptation of rods, wire ropes and chains, passing over vibrating levers and guide pulleys. By this means many wells producing too little for profitable individual pumping, are operated very cheaply from one common engine and boiler.

Jerk Water.—A railroad term for the Ramsbottom water trough system of supplying water to a locomotive while in motion.

Jet.—1. That which spurts or shoots out.

2. A spout or nozzle; as, a gas jet.

3. A course of projecting bricks, as in a brick kiln.

Jet Compressor.—A type of air compressor in which the heat generated by compression is absorbed by a spray of water, injected into the cylinders; some types have the cylinders jacketed and use an intercooler between the two stages of compression.

Jet Condenser.—A chamber or vessel within which the exhaust steam from an engine meets a spray or jet of water and is condensed. The heated cooling water, condensed steam, and liberated air are removed from the condenser by the air pump, which delivers the water into the hot well, whence the feed water supply is taken by the pumps, the surplus escaping through the overflow.

Jet Propulsion.—An application of power to propel ships by the reaction of a jet of water expelled through orifices at the rear end of the vessel.

Jet Pump.—An ejector; a pump which delivers large quantities of fluid at a low lift by means of the momentum imparted to the column by the velocity of a jet of steam or compressed air.

Jetsam.—In marine law, the cargo, etc., thrown overboard to lighten a ship.

Jetting.—In civil engineering, sinking piling by means of a force pump. The water is forced through a rubber hose and iron pipe and removes, by its action, the sand, clay, or other substances, leaving a hole for the piling to sink in. It is also used for removing piling, as by the force of the water, the ground becomes loosened and the piles can be extracted.

Jetting Out.—In architecture, the projection of a corbel or moulding beyond the general surface.

Jettison.—The same as jetsam; the act of throwing overboard; as, goods, especially to lighten a vessel in danger.

Jetty.—In civil engineering, a construction of wood, rubble stone, masonry or concrete, projecting into the sea and serving as a wharf or pier for landing and shipping, or as a mole to protect a harbor; as, the jetty at the mouth of the Mississippi.

Jewel.—1. A bit of precious stone, crystal or glass, used to form a durable bearing; as, for a watch pivot. A watch is said to be full jeweled when it has thirteen jewels.

2. A boss of glass or enamel in a window or on glass or enamel.

Jewelers' Tools.—The jewelers' workbench is scooped out to a semi circle to fit his body, forming a *bow*. Each bow is fitted with a leather *apron* to catch droppings of precious metals and tools. The bench tools, usually employed, are a *sparrowhawk* or small beak anvil; a doming block, with a set of suitable punches, for making curved surfaces; *nippers* for cutting wires and sheet metal, and for piercing; *treblets* or beaks for forming finger rings and the edges of collars, lockets and bracelets; a *drill stock* and *fiddle* or *archimedeian drill*; *snarling irons* for repoussé work; *broaches*, *burnishers*, *chasers* and *matting tools*; *files* (needle, round, flat, three squared, ruffle and crochet); *blowpipe*, etc.; *drawplate* for wire; *hammer* and *mallet* for different work; *pliers*; *screw plate* and *taps*; *vices*, both bench and hand, etc.

Jib.—In a ship, a large triangular sail, set on a stay forward of the foremast.

Jib Boom.—The spar or boom mounted on the bowsprit to carry the jibs; beyond this is sometimes extended the flying jib boom.

Jib Crane.—One that lifts weights at the extremity of an inclined arm or jib; this differs from a derrick, in that, the load

cannot be lifted by the topping lifts or peak blocks, as the jib is supported by rigid stays.

Jibe.—A marine term, indicating the shifting of a boom sail from one tack to another.

Jig.—1. In coal mining, a self acting incline, in which loaded cars descending, haul up the empty ones by means of a rope passing over pulleys.

2. In ore dressing, a box with a perforated bottom, *jigged* or moved up and down in water, so that broken ore placed in it is arranged in layers according to specific gravity.

3. In well boring, to drill with a spring pole.

4. In machinery, a mould or form contrived to hold castings or forgings so that necessary holes may be uniformly and rapidly bored in them, thus obviating marking off, and ensuring accuracy as well as economy.

Jig Brow.—The crest of a jig or self acting incline.

Jigger.—1. A potter's wheel, a throwing wheel.

2. A clay working machine used to knead and incorporate the clay.

3. A fore and aft rigged mast placed abaft the mizzen in four masted ships and barks.

Jig Pump.—A portable force pump.

Jig Saw.—An upright saw, to which a reciprocating motion is given by a crank and connecting rod or pitman, the saw frame sliding in vertical guides.

Jim Crow.—1. A rail bender, consisting of a strong semi-elliptical dog which grips the rail while a screw is applied at the center of its span, thus curving the rail as desired.

2. In mining, a crowbar with one end clawed like a hammer.

3. In metal working, a planing machine that cuts on both strokes of the table, the tool head facing about for the purpose.

Jimmy.—Same as jimmey.

Jinny.—A spinning jinny, as used in a cotton mill, in the spinning room.

Jinny Road.—In mining, an inclined road in a coal mine, on which loaded cars descend by gravity, drawing up empty ones. The term is derived from the old word *gin*, an engine.

Job.—A piece of chance or occasional work, any definite work undertaken in gross, for a fixed price; as, he did the *job* for ten dollars.

Jobber.—One who works by the job.

Jobbing.—Doing chance work or odd jobs; as, a jobbing carpenter.

Jockey Pulley.—A small idle pulley riding on a driving belt or rope to keep it taut. Generally known as a *tightener*.

Jockey Weight.—A weight which is slid along a lever, in a weighing or testing machine, for precise adjustment.

Joggle.—To join overlapping parts together by means of notches in one and projections on the other, so that they shall interlock and not be able to slide upon one another. Used in scarfing or splicing beams or in splicing bar frames of locomotives, etc.

Join.—1. To couple or combine, to connect one with another.

2. To associate with, to make alliance with.

Joiner.—A mechanic who fits and finishes or *joins* internal and external woodwork, such as boarding, doors, partitions, wainscoting, window sashes and the like, as distinguished from the heavy framing and mortised work, which belongs to the *carpenter*. In shipyards, the shipwrights are *carpenters*, those who fit the woodwork inside the cabins are *joiners*.

Joinery.—The art or trade of a joiner. Matched, moulded and fitted work dealing with boards and small scantlings, rather than tenoned work, framing and heavy work which constitute *carpentry*.

Joint.—The place or part in which two things are joined or united; the union of two or more smooth or even surfaces admitting of a close fitting or junction; as, a joint between two pieces of timber.

Joint Chair.—In railways, the chair that supports two adjacent rail ends.

Jointed Axle.—In automobiles, an axle in which either end that carries a wheel, is jointed to the main portion, to secure flexibility.

Jointer.—1. A tool used by masons for filling the cracks in mortar between two adjacent courses of stone or brick.

2. A saw that squares the edges of boards, making them parallel to each other and at right angles to the edges of the boards.

3. A bent piece of iron built into a wall to strengthen it.

Jointer Plane.—A carpenters' plane, with a stock about thirty inches long, used to true up the edges of planks where they join together.

Joint Fastening.—In railways, any contrivance that holds two adjacent rail ends together or at the same level.

Joint File.—A small round file, without taper, used for dressing the holes for pintles of hinges, etc.

Jointing Machine.—In cooperage, a planing machine for dressing the edges of the staves.

Joint Pin.—A pin on which a double eye or forked joint is hinged, the pin fitting tightly in one member and hinged in the other.

Joist.—1. One of the smaller horizontal beams which carry the floors of a building or to which the laths of a ceiling are nailed.

2. A rolled steel beam of I section, used for a variety of purposes in structural work.

Joist Hanger.—In carpentry, an iron shaped like the letter U with hooks on both ends to overhang on the girder and support the joist without cutting into the timber. Also called *stirrup iron*.

Jollyng.—In pottery, the formation of hollow circular pieces by a machine. A two piece plaster of paris mould reproduces the outside of the piece and fits into a receptacle under the machine spindle. A slab of clay is prepared and pressed into the mould by means of a dome shaped piece covered with coarse flannel; this is withdrawn, leaving the clay in the mould. A steel profile is then introduced and revolved, making the vessel of the correct interior shape and the proper thickness of wall.

Jones, William Richard.—Born 1839, died 1889. An American engineer, distinguished for his services in building up the great Carnegie system of steel manufacture. He took out a dozen patents connected with the making of steel, the first of which (1876), was a device for operating Bessemer ladles, and the last (1889), a method of mixing the metal from blast furnaces. He met a tragic death by the explosion of a troublesome blast furnace which he was personally endeavoring to bring under control.

Jonval Turbine.—In hydraulics, a parallel flow turbine of the reaction type. It is usually placed vertically within an

air tight conduit or race, the lower portion of which discharges below the tail race, constituting the *suction tube* or *draft tube*.

Joule's Equivalent.—The mechanical equivalent of heat, as determined by Dr. Joule, is 772 foot pounds, for 1 unit of heat, or the power expended to raise 1 lb. water 1 degree Fahrenheit.

Journal Bearing.—The separate step or "brass" fitted into a journal box, with which the axle comes into contact.

Journal Box.—An axle box of a railway car.

Journals.—Those portions of a shaft or axle, which work within the bearings; that part of a shaft or spindle revolving on the brasses.

Joy Valve Gear.—A form of valve gear which derives its motion from an arm attached to the connecting rod near the wrist pin. The link is pivoted at its upper end and by moving it forward or backward from the central position, the cut off can be regulated.

J. P.—Abbreviation for Justice of the Peace.

Jump.—In mining, a slight fault or dislocation in a vein.

Jumper.—In mining, (1) a drilling tool, worked by hand, having a chisel point at each end, and swelled out in the middle to give weight to the blow; (2) a drill, struck by a hammer.

Jump Joint.—In millwrighting, a belt joint made by bringing the ends together, end to end, and then lacing. Also called a *butt joint*.

Jump or Upset.—In blacksmithing, to shorten and thicken at the end by a forging process.

Jump Spark Circuit.—The current is led from its source through the wiring to the *sparking plug*, wherein is an insulated platinum point set at about $\frac{1}{8}$ inch from a similar point which is connected with the cylinder shell, and grounded on the engine. Occasionally, a complete circuit is used.

Jump Spark Coil.—In an automobile, the induction coil used in connection with jump spark ignition.

Jump Spark Ignition.—Electric ignition of the explosive charge in internal combustion engines by means of a spark or arc forming across the gap between two metallic points. The electric current is of high tension, produced either by storage or primary batteries in connection with an induction coil, or else generated by a magneto. A vibrator or trembler is generally used to occasion a succession of sparks rather than a single one, the contact is made and broken by a commutator connected with the engine which controls the timing for the different cylinders.

Jump Weld.—In blacksmithing, a butt welded joint, formed by bringing the ends of a bar together, and *jumping* them upon the anvil, or with a heavy hammer.

Junk.—1. Old rope; old planking; odds and ends.

2. A Chinese vessel more or less square at the ends, with a high forecastle and poop, carrying lug sails.

Junk Ring.—In a steam engine, a plate or follower that holds the packing rings in place on the piston; formerly pistons were packed with junk or rope.

Junk Ring Bolts.—In a steam engine, the bolts which screw into the piston body and hold the junk ring in place.

Jute.—Fibers extracted from plants of the *Corchorus* or jute plant, indigenous to Bengal; it is largely used in the manufacture of sacks, matting, hessians and similar coarse fabrics, but seldom spun into rope.



K.—The eleventh letter in the English alphabet.

Kaleidoscope.—An optical toy consisting of a tubular body with two or three mirrors arranged at angles of 60°. Small pieces of colored glass, beads, etc., are placed in a glass compartment at the end, and on looking through the tube, the objects and their reflections form symmetrical patterns, which change as the instrument is rotated. The toy is sometimes used by designers.

Kalsomine.—A trade name, corrupted from *calcimine*; a white or colored wash for the walls of rooms, ceilings, etc.

Kaolin.—China clay, formed by the decomposition of crystalline rocks. It is used for making the finest porcelain, and is of pearly white appearance, becoming translucent on firing.

Kauri Pine.—A tall coniferous tree (*Dammata australis*), found in New Zealand. It furnishes a light colored, straight grained wood, suitable for masts and shipbuilding; it is durable and works well. The tree exudes a gum or *copal*, which is used in varnish manufacture. The fresh resin is not used, only that dug up in a semi-fossil state being used in commerce, this being found in lumps of a hundred weight or more. The kauri gum takes up more oil and can be worked at a lower temperature than any other copal.

Kedge.—A small anchor capable of being carried in one of a ship's boats, and used as a holdfast at the end of a warping line.

Keel.—The spine of a ship; the central longitudinal member or chief timbers of her framing.

Keel Condenser.—A surface condensing device applied to steam launches and the like. It consists of a copper tube beside the keel, through which the exhaust steam is drawn by the air pump, being condensed on the passage by contact with the surfaces kept cool by the sea water. The boat thus acts as her own circulating pump.

Keelson.—A longitudinal girder in a ship's framing between bilge and bilge; above the bilge they are known as stringers.

Keen.—Sharp; having a fine edge or point; as, a keen razor.

Keep.—To hold; not to let go of; to retain; as, to keep to a rail. The cap or cover of a bearing which retains the top brass in place.

Keeve.—In brewing, a vat or tub in which the mash is made; in mining, a large vat used in dressing ores.

Keg.—A small cask or barrel, usually of a capacity of from 5 to 10 gallons.

Kemp.—In woolen manufactures, coarse rough hair in wool, injuring its quality, and deteriorating the appearance, even of common fabrics, by its inferiority and harshness, and by its not taking the dye readily.

Ken.—To know; to understand; reach of sight or knowledge.

Kentledge.—Blocks of pig iron with handles cast into them and roughly shaped to fit the bottom of small sailing craft and used as ballast.

Kerf.—The cut of an axe, a saw, or other instrument; the notch or slit made in wood by cutting or sawing.

Kernel.—A small mass around which other matter is concentered; a nucleus; the central part of anything.

Kerosene.—A mineral hydrocarbon oil, distilled from petroleum or coal oil. It is the second series of fractional distillates, first coming the lightest or gasolenes; then the illuminating oils or kerosene; then "solar oil" for gas enrichment, "middlings" used as fuel, and the final residue, whose uses vary with the nature and locality of the petroleum, sometimes being used as fuel, sometimes having lubricating oils of different densities distilled from it, until nothing is left but a solid residue or coke.

Ketch.—A small vessel rigged with two masts of which the forward or main, is the higher and larger; the mizzen mast is stepped forward of the stern post.

Kettle.—A vessel of iron, or other metal, with a wide mouth, usually without a cover, used for heating and boiling water or other liquids.

Kevel.—1. A stone mason's hammer (written also cavi).
 2. A strong cleat to which large ropes are belayed.

Kevel Head.—A marine term, denoting a projecting end of a timber used as a kevel.

Key.—1. A lever, one of a series in a musical instrument, operated by the fingers of the performer.

2. A similar lever for manipulating one particular letter or sign in a typewriter, linotype machine, etc.; or a lever or button operated by the fingers in connection with any instrument or machine.

3. A device in telegraphy, consisting of a lever whereby contacts are made or broken, thus furnishing electric signals.

4. A tapering piece, fitting into grooves in a shaft and the wheel boss surrounding it, by means of which the two are secured together.

5. A spanner or wrench to turn a coupling piece, nut, etc.

6. An instrument for shooting the bolts of a lock; as, a door key.

7. The plug of a cock (used locally in Scotland and some parts of the U. S.).

8. A fastening piece driven in to secure anything, similarly to a forelock, or the gibs and cotters whereby bearing brasses are secured or adjusted.

9. An oaken wedge, used in railway engineering; it is driven in between a rail and the jaw of the chair which supports it, thus locking the former.

10. An instrument or implement which has to be inserted and turned, in similar manner to a door key.

Key Bed.—A groove or excavation made to receive a key for the purpose of binding the parts, as of a machine, tightly and firmly together.

Keyboard.—The banks of keys in an instrument such as an organ or piano-forte; hence a similar arrangement of keys in a typewriter, linotype machine, etc.

Key Bolt.—A plain unthreaded bolt or pin, used to secure pieces of machinery together; and as the pin of a shackle or clevis; it is secured by means of a forelock split cotter or key.

Key Boss.—In machinery, a small swell or projection cast on the outside of the boss of a wheel or pulley, opposite and outside the keyway in order to maintain the same thickness of metal around that, as around the central hole. Without this addition the cutting of the keyway would become a source of weakness.

Key Gauges.—In machinery, plate gauges, both male and female, used for checking the width of keys and key seatings, the one being notched to embrace

the sides of keys of a given size, the fellow one fitting closely within this notch, and used to check the corresponding width of the keyway.

Keyhole.—A hole or aperture in a door or lock, for receiving a key.

Keyhole Saw.—A narrow slender saw, used in cutting keyholes, etc., as in doors; a kind of compass saw or fret saw.

Key Lever.—In a typewriting machine, a lever upon one extremity of which the key is mounted, thus transmitting the motion of the operator's fingers to the type bar.

Key Seat.—A rectangular groove, especially in a wheel and shaft, to receive a key, so as to prevent one part from turning on the other.

Key Seating Machine.—A machine tool for forming keyways in the hubs of flywheels, pulleys, etc. The cutter resembles a saw, and is operated from beneath, the work being laid horizontally upon the table and the tool fed to the cut.

Keystone.—In architecture, the wedge piece at the vertex of an arch which locks its components together; properly speaking all the stones of an arch are equally important.

Key Valve.—The pad or plug which closes an aperture in a musical wind instrument, and sounds the note on being lifted to let the air pass through.

Keyway.—A groove or recess formed in a shaft, or in the hub of a wheel into which such shaft fits. Also termed *key bed*.

Keyway Calipers.—A form of spring dividers employed to measure the thickness of metal between the top of a key bed and the circumference of the hub or boss. One leg is straight and a true plane, the other is curved, the straight leg fitting in the keyway and the curved one being set to the outside of the hub.

Key Wrench.—In machinery, a lever used for tightening up keys; also called *key spanner*.

Kibble.—In mining, an iron bucket used to raise or lower men, ore, and supplies.

Kiddle.—A kind of basket work weir in a river for catching fish.

Kieselguhr.—Infusorial earth, the fossil remains of the siliceous parts of diatoms (microscopical links between the animal and vegetable kingdoms). Large deposits are found in the valley of the Elbe, in Virginia, Nevada, and California. Used as a polishing material, as an absorbent, combined with nitroglycerin to form dynamite, and as a non-conducting covering of boilers and steam pipes.

Killas.—In mining, a term for slate or slaty clay; generally for any rock but granite or elvan.

Killing.—In metal working, the addition of zinc to spirits of salts or hydrochloric acid to form a *chloride of zinc*, as a flux to remove the oxide from surfaces which have to be soldered.

Kiln.—1. A large stove or oven; a fabric of brick or stone which may be heated for the purpose of hardening, burning, or drying anything; as, a kiln for baking or hardening earthen vessels.

2. A pile of brick constructed for burning or hardening; called also, brick kiln.

3. A building in which malt, hops, timber, etc., are dried by the application of heat, without coming into contact with the flames.

Kiln Drying.—The operation or process of drying timber, within a chamber, through which currents of heated air circulate from a furnace. Similar processes are employed for drying barley, malt, hops, etc.

Kiln Run Brick.—This embraces all brick hard enough for the outside of a building; they are divided into *hard, common building, paving, outside, hard red, strictly hard, select hard, rough hard, hard washed, kiln run hard, common hard and hard building brick*.

Kilogramme.—The general metric unit of weight, equaling 1000 grammes or 2½ lbs. avoirdupois, nearly.

Kilometre.—The standard metric measurement of distances, equaling 1000 metres, .62 mile or 1094 yds., nearly.

Kilowatt.—The standard of comparison for electrical energy as the horse power of 33,000 minute foot pounds is the standard of mechanical energy. The kilowatt equals 1000 *watts* or *volt-amperes*, and one kilowatt per minute = $\frac{1000}{748} = 1.34$ h. p.

Kin.—Of the same nature or kind.

Kindle.—To set on fire; to cause to burn with flame; to ignite; as, to kindle a fire.

Kinematic Chain.—One composed of a series of kinematic links, so paired together that the movement of each link is absolutely constrained in relation to all others in the chain. When a single link of a kinematic chain is fixed, a mechanism is produced. When the links of a kinematic chain contain only two elements, it is termed simple, when some links contain more than two elements, it is termed a compound chain.

Kinematic Elements.—In mechanics, signifies certain profiles, forms, or methods of constraint imparted to bodies in mutual engagement or connection, by means of which their relative motions are absolutely constrained in all possible positions of the bodies. These elements must of necessity always occur in pairs, and they are the fundamental elements in all mechanism. The most important are the *turning pairs* and the *sliding pairs*. The type of the first is the revolving pin with collars, that of the second, the sliding block or guide block. The methods of constraining may either take place by surface contact, as in all journal bearings and machine slides, and in this case, the term *lower pairs*, is applied to the elements, or they may take place by line contact only, as in the case of cams and screw gears, in which case, the term *higher pairs*, is employed. A third pair of elements is the *twisting pair*, of which the common screw and nut is a familiar example.

Kinematic Links.—In machinery, bodies which are essential and elementary parts of all mechanisms; as, rods, levers, etc., which are connected together by two or more kinematic elements, by which their relative movements are rigidly constrained.

Kinematics.—1. The science dealing with the motion of bodies, having regard to space alone, and without reference to the forces which produce those motions.

2. The theory of the motions of parts of machines, whereby they are constrained to fulfill their various functions, one variety of motion being employed to produce another.

Kinetic Energy.—The energy or stored capacity for performing work possessed by a moving body, by virtue of its momentum. It represents the work necessary to bring the body from its actual velocity to a state of rest. The measure of actual energy is the product of the weight of the body, multiplied by the height from which it must fall to acquire its actual velocity.

Kinetic Theory of Gases.—That theory of the properties of gases based upon the assumption that a gas consists of separate molecules, each possessing a finite mass and velocity and obeying the ordinary laws of motion.

Kinetoscope.—An instrument for producing curves by the combination of circular movements; called also *kinescope*.

King Bolt.—1. A vertical iron bolt, by which the forward axle and wheels of a vehicle, or the trucks of a railroad car are connected with the other parts.

2. The connection for the king rod in a paddle wheel.

King Leg.—The principal or vertical leg of a *tripod* supporting a derrick, etc.; the other legs are known as *queen legs*.

King Pin or Center Pin.—A large bolt or pivot passing through the center casting of an engine truck, or the center plates of the body and truck bolsters of a tender.

King Post.—In carpentry, a main post coming vertically beneath the crown or ridge of a roof truss.

King Post Truss.—A truss or roof principal constructed with a king post.

King Rod.—In a steam vessel, a heavy rod connecting the paddle wheel to the feathering eccentric and giving motion to the latter.

Kingston Valve.—A sea valve in which the miter is reversed, the larger diameter of the valve being outside; this is to close the valve automatically by pressure of the water in the event of the spindle breaking.

Kink.—A twist or loop in a rope or thread caused by a doubling or winding upon itself; a close loop or curl; a doubling in a cord.

Kips.—Leather obtained from young or small cattle; intermediate between calfskin and cowhide.

Kirk's Analysis.—A system devised by the late Dr. Alexander Kirk to compare the forms and power of steamships, in which the curved surfaces of the hull are reduced to plane figures, easily calculable within a very small error. The diagram for these plane figures is known as the Block Model.

Kish.—A shop term for the black scales of graphite which separate and float on the surface of a slowly cooling mass of molten iron. The whole of the *scum* is also called kish.

Kit.—A box containing implements or domestic necessities; hence, an outfit of tools, accessories or personal possessions

for any particular calling; such as a plumber's kit of tools, or a sailor's kit of clothing; small implements and personal necessities.

Kite.—A light frame of wood or other material covered with paper or cloth, for flying in the air at the end of a string.

Knack.—A readiness in performance; aptness at doing something; skill; dexterity.

Knapsack.—A case of canvas or leather for carrying things on a traveler's back.

Kneading Machine.—A contrivance for mixing, incorporating and kneading dough, as used in large bakeries.

Knee Bracing.—In carpentry, a piece of wood having a natural bend, or sawed into shape, to fit into an angle, as a brace or strut.

Knee Joint.—A toggle or toggle joint; so called because consisting of two pieces jointed to each other, end to end, making an angle like the knee when bent.

Kneeler.—A masonry term denoting: (1) a squared seating worked in coping stones on a raked parapet; (2) a stone placed at the base of the slant of a gable or at a higher level on the same slope, its seat being squared or horizontal while one face is cut to the angle of the gable, the purpose being to relieve a portion of the diagonal thrust.

Kneeroom.—In vehicles, the room provided where passengers sit facing one another, and generally including provision for passage as well as for two sets of knees.

Knife.—1. An instrument consisting of a thin blade, usually of steel, and having a sharp edge for cutting, fastened to a handle; as, table knife, putty knife, pocket knife, chopping knife, etc.

2. In agricultural machinery, the scythe or moving part of the cutter bar of a reaping machine.

Knife Blade Rolls.—A machine for shaping blades of table knives, etc. Cam pieces are attached to each of a pair of rolls, geared together, each cam having an engraved surface or die corresponding to the half thickness of the proposed blade. On thrusting a piece of steel between the rolls, the revolutions of the cams gradually compress the metal into the die and forge it to shape and thickness.

Knife Edge.—A steel stud or projection, shaped to a sharp edge, which works upon a horizontal surface or the inner circumference of a ring: used as a means of suspension for a scale beam, etc., or to connect a safety valve lever with its fulcrum, as friction is obviated by removing it from a surface to a line.

Knife Key.—In drawing instruments, a key with prongs for tightening the joints of compasses, but containing, in addition, a rigid *knife blade* at the opposite end, and a *file* placed intermediately.

Knife Tool.—A tool with a steel plate sharpened to an acute edge or angle and used for cutting purposes.

Knitting.—Consists in the making of a looped fabric in which for the first row, a succession of loops are cast on or preferably knitted on to a *needle*, and in the following rows each loop is passed through the loop of each succeeding row.

Knitting Machine.—An apparatus for knitting; that is, making a fabric by the enchainment of a single thread. It is furnished with a number of hooked and barbed needles, and also loopers for forming the meshes, and is used upon hosiery, jerseys and the like.

Knob.—A rounded handle or protuberance upon anything; as, the *knob* or handle on the spindle of a lock; as, a door knob.

Knock.—To strike or beat with something hard or heavy; as, to knock at a door.

Knock Down.—A piece of furniture made so as to be taken apart in order to pack closely for shipment. Chairs are a special illustration; backs, legs, seats and rungs being bundled together by dozens at the factories, and set up at the place of sale. A *shook* is a barrel knocked down.

Knocker.—An instrument, or kind of hammer, fastened to a door to be used in seeking admittance.

Knockings.—1. In mining, the larger pieces of ore or stone blasted or cut off from the vein or bed.

2. In masonry, the small pieces chipped off in shaping or dressing the stones.

Knock Off Joint.—In well drilling, a joint used in the rods of deep well pumps. The jointed ends of the rods are enlarged

to a square section and scarfed and notched to fit against one another, and are confined by a clasp or bridle embracing them. The joint is tapered lengthwise and the hole in the clasp is tapered to correspond, so that the tendency is always for the clasp to tighten around the joint.

Knopping.—In spinning, the production of knobs on yarn as it is drawn by means of checking and then releasing the motion, thus forming a fancy yarn.

Knot.—1. A hard place in a piece of wood caused by the shooting of a branch obliquely through the annual rings formed by the growth of the tree.

2. A complication of threads, cords, or ropes, formed by tying, knitting, or entangling, and resisting separation of loosing; a close tie; a fastening of cord.

3. A unit of speed or velocity of navigation. For measuring the speed of ships, the customary unit is the *knot*; while this term is often used as a distance it is really a *speed or velocity*, each division of the log line serving to measure the rate of the ship's motion. Each knot on the line bears the same proportion to a mile that thirty seconds do to an hour; the number of knots which run off from the reel in half a minute, therefore, shows the number of miles the vessel sails in an hour. As adopted by the U. S., the knot is a speed of 6080 $\frac{2}{3}$ feet per hour, the British knot is a speed of 6080 feet per hour.

Knottng.—The material used by painters to 'kill' the knots in woodwork. Patent knotting consists of shellac dissolved in naphtha. Size knotting is red lead ground in hot water and mixed with strong glue size: this is followed by a second coat of red lead mixed with boiled oil and turpentine. Occasionally lime is employed; this is left on for twenty four hours, then scraped off and followed by size knotting.

Knowledge.—1. The act of knowing; clear and certain perception of truth and duty; certain apprehension.

2. That which is gained and preserved by knowing; actual acquaintance gained by learning; instruction; acquaintance; enlightenment; learning.

Knub.—In silk manufacture, the waste silk which cannot be unwound from the inner part of the cocoon.

Knuckle Joint.—In machinery, a box embracing a pin held at both ends by the forked end of a connecting rod.

Knuckle Pin.—On a locomotive, the pivot on which the knuckle of the pilot or tender coupler turns. Also called *pivot pin*.

Knuckles.—1. In mechanics, the joining parts of a hinge through which the pin or rivet passes; a knuckle joint.

2. The laterally swinging hook of a locomotive automatic coupling, which engages in the

catch or lock, thus effecting the coupling of a railway car. It must conform to certain standard contours adopted by the Master Car Builders' Association. (M. C. B.)

Knurled.—1. Having knurls; that is, full of or covered with knots and protuberances.

2. Milled; having the edges cut into a succession of ridges to afford grip for the fingers; as, the head of a screw or the edge of a coin.

Knurling.—The process of knurling or milling the edge of an object, by means of a suitably shaped rotary cutter, which has ridges around its edge.

Knurling Tool.—In machine work, a tool used to press indentations into the edges or upon the surfaces of metal in order to increase the hand grip of it.

Kodak.—A special type of hand camera for photography, furnished with a roll of continuous sensitized film, upon which photographic negatives are made by successive exposures.

Kofer.—In mining, the mortar or trough which holds the material operated upon by the stamps; the same as coffer.

Krupp, Alfred.—Born 1812, died 1887.

A German metallurgist, inventor and manufacturer. Having assumed control of the steel works established by his father at Essen, Prussia, he devoted himself to the improvement of the manufacture of steel, receiving in 1844 a gold medal for the fine quality of his output, until in 1851 he had become the leading steel maker of the world; he invented the breech loading mechanism for rifles and cannon (1861), and after that his factory was chiefly employed in the manufacture of heavy guns and armor plate, which have given the Krupp works a world wide reputation.

Krupp Armor.—Armor plating of steel, the face of which has undergone cementation so that an extremely hard surface is obtained in combination with a tough homogenous backing; 4 inches of this material presents as great resistance to armor piercing projectiles as 9 inches of wrought iron.

Kyanizing.—In civil engineering, the preservation of timber by impregnation with a solution of corrosive sublimate or chloride of mercury. The proportions are one pound of sublimate to ten gallons of water for maximum strength, or one pound to fifteen gallons as a minimum. About twenty four hours per inch of thickness are required for saturation.



L.—The twelfth letter of the English alphabet, and a vocal consonant. It is usually called a *semi vowel* or liquid. As a numeral, L stands for 50 in the Roman table.

Label.—1. A slip of paper, parchment or other material, on which is written or printed the name, destination or nature of anything to which it may be affixed.

2. A projecting moulding, of square section, over the heads of doors and windows; used on the outside of a building to shed the rain; in the interior for ornament.

Labor.—Physical toil or bodily exertion, especially when fatiguing or unavoidable; hard, muscular effort directed to some useful end; as, manufactures and the like.

Laboratory.—A place where operations and experiments are performed; a place where anything is prepared for use.

Laborer.—An unskilled workman; one pursuing a vocation where physical strength is required instead of skill or training.

Labyrinth.—1. A chamber with many deflectors, diaphragms or baffles, forming winding passages wherein are cooled and condensed the fumes of mercury, other vapors arising from dry distillation, or smoke.

2. In mining, a series of winding channels or troughs formerly employed in concentrating slimes according to the coarseness of the ore.

Lac.—A dark red resinous incrustation deposited on the twigs of certain trees in Hindostan by an insect, *Carteria lacca*. The female insect exudes the gum and uses it to enclose her eggs and attach them to the twig. The natives break off the twigs, and expose them to the sun, to kill the eggs and insect, and dry the lac, this forms *stick lac*. The lac is removed from the twigs, and triturated in water, the granulous deposit, after drying, being *seed lac*. *Shell lac* or shellac is formed from seed lac, by melting it in cotton bags, straining, and allowing it to drop on plates or leaves, forming the familiar scales. *Button lac* differs only from shellac in that it is dropped into thin disc forms, three inches in diameter. *Lac dye* is the coloring matter washed out from the stick lac in triturating it to form seed lac.

Lace.—That which binds or holds, especially by being interwoven; a string,

cord, or band, usually one passing through eyelets or other holes, as used in drawing and holding together parts of a *belt*.

Lace Cutters.—In mechanics, instruments for cutting up sides of lace leather into strips, convenient for belt fastenings.

Lace Leather.—Oil tanned leather suitable to cut into thongs or laces, for uniting the ends of belting by passing through holes in the belt.

Lacing.—The union, by means of laces, of the ends of leather belting in driving machines. The distance around the pulleys being taken, the belt is made to overlap in a loop somewhat smaller than that given by the actual measurement in order to allow for after stretching, and the overlapping ends are pierced with holes through which the laces are threaded. *Belt screws*, etc., have, however, largely superseded laces for this purpose.

Lack.—To be without or destitute of; to want; to need.

Lacquer.—A yellowish varnish, consisting of a solution of shellac in alcohol, colored by gamboge, saffron, and the like. It is used chiefly for varnishing brass and some other metals, in order to give them a golden color and preserve their luster.

Lactic Acid.—In physiological chemistry, a sirupy, colorless fluid, soluble in water, with an intensely *sour* taste and a strong acid reaction.

Lactometer.—An instrument for measuring the density of milk.

Lacustrine Deposits.—In hydraulics, the deposits which have been accumulated in fresh water areas.

Lacustrine Dwellings.—In building construction, dwellings built over a lake, sometimes on piles and sometimes on rude foundations kept in place by piles. Also called *lake dwellings*, as the ancient city of Venice.

Ladder.—A frame of wood, metal, rope etc., consisting of two side pieces, con

ned by rungs inserted at suitable distances, and thus forming steps by which persons may ascend a building, etc.

Ladder Dredger.—One of the more usual types, in which an endless chain of buckets travels over a boom or ladder, the outboard end of which is elevated or depressed, to suit the required depth of excavation.

Ladder Work.—Work in the performance of which, a ladder is necessary; as, in painting the walls of a house and the like.

Ladle.—In founding, a frustum shaped vessel of wrought iron, lined with fire clay or other refractory material, used for the conveyance of molten metal from the furnace to the mould.

Lag.—1. In steam engineering, the amount of retardation of anything; as, of a valve in a steam engine, in opening or closing.

3. In machinery, one of the narrow boards or staves forming the covering of a round body; as, a boiler, or the cylinder of a carding machine or a steam engine cylinder.

3. In carpentry, narrow planks extending from one rib to another in the centering of arches and forming the board covering upon which the courses of voussoirs are laid.

Lagan.—A law term, signifying sunken goods to which a buoy is attached. Also spelled lagend.

Legend.—That end which causes the delaying or retardation.

Lagging.—Non conducting material placed around boilers, pipes, engine cylinders, etc.

Lag of the Tide.—The interval by which the time of high water falls behind the mean time, in the first and third quarters of the moon. Opposed to *priming of the tide*, or the acceleration of the time of high water in the second and fourth quarters; depending on the relative positions of sun and moon.

Lagoon.—A shallow lake bordering on the sea, but separated from it usually by a sand spit or a ridge of sand dunes. Lagoons are usually formed near the mouths of rivers which bring down considerable detritus. Coral lagoons are formed by the action of coral insects, which either build a wall across a bay or inlet, or else encircle an islet with a circular ring of coral.

Lag Screw.—A wood screw provided with a square or hexagon head, so that it may be turned by a spanner or wrench.

Laid.—In paper manufacture, paper having the marks made by the wires of the *deckle*. The choice of coloring matter determines the names, *cream laid*, *blue laid*, etc.

Laitance.—In foundation work, a pulpy and gelatinous fluid, of a milky hue, washed from cement upon its being deposited in water, more abundantly in salt than in fresh. The laitance sets very imperfectly and has a tendency to deteriorate the cement.

Lambskin.—1. A kind of woolen cloth.

2. The skin of a lamb; especially, a skin dressed with the wool on and used as a mat.

Lamina.—A thin layer of metal, mineral, as of mica, tissue, etc. *Laminae* is the plural of *lamina*.

Laminate.—To beat, roll or press into thin sheets; as, a metal.

Laminated Springs.—These are constructed of long, narrow, flat plates of spring steel, bent to a camber or curve, fastened in the middle by a buckle, with a suitable attachment to the load, and supported at the ends by links or hangers.

Lamination.—1. Building up or composed of flat thin plates; as, the cores of electrical transformers.

2. In geology, the natural arrangement of rocks so that they split into thin sheets.

3. In engineering, a defect of shafts, plates, etc., caused by peeling off of the surface in thin layers or scales, due to imperfect forging or the presence of layers of cinder between the pieces of metal piled or fagoted together when rolled.

Lamp.—A vessel in which oil or kindred substances may be burned for the production of light; consisting of a reservoir for the illuminant, a wick wherewith to supply the flame, and a glass chimney or globe to shield it and promote the draught necessary for combustion.

Lamp Black.—Fine soot, formed by the condensation of burning hydrocarbons. *Lamp black* was originally made by means of a lamp or torch.

Lamp Post.—A post (generally a pillar of iron) supporting a lamp or lantern for lighting a street or park.

Lancashire Boiler.—This is an improved boiler of the Cornish type; it has two internal furnaces instead of one. These furnaces are sometimes each continued as a separate flue to the other end of the boiler;

but as a rule they emerge into one internal flue. They are supposed to be fired alternately, and the smoke and unburned gases issuing from the fresh fuel are ignited in the flue by the hot air proceeding from the other furnace, the fuel in which is in a state of incandescence. Thus all violent changes in the temperature are avoided, and the waste of fuel due to unburned gases is largely avoided.

Lancet.—In founding, an iron bar used for tapping a melting furnace.

2. In architecture, a pointed arch, of which the width or span is narrow compared with the height.

3. An instrument of various forms, commonly sharp pointed and two edged, used by surgeons.

Land.—In tools, that part of a tap or a reamer that lies between its plates and carries the cutting edges or teeth.

Land Engine.—A term applied to distinguish ordinary stationary engines from those of marine and locomotive types. It designates no type of engine in particular, whether horizontal, vertical, beam, or otherwise, or high or low pressure.

Lander.—In mining, a person who waits at the mouth of the shaft to receive the *kibble* of ore.

Landing.—1. In boiler construction, that portion of a riveted lap joint which lies between the outside rivets, or the distance between the outer rivet holes and the edge of the lap.

2. The first part of a floor at the end of a flight of steps.

3. A pier, wharf or jetty, by a riverside, for landing passengers or goods from vessels.

Landlocked.—Well surrounded and protected by land; said of a body of water; as, a *landlocked harbor*.

Land Measure.—A table of square measurement employed in the mensuration of land.

Landslip.—The sliding down of a considerable portion of earth from a higher to a lower level; the soil is loosened by rains, washouts, or the action of frost, and, lying at an angle steeper than that of repose, it slides down into the valley.

Land Spout.—A descent of cloud and water, in a conical form during a tornado and a heavy rainfall on land. Opposed to water spout.

Land Surveyor.—One who follows that branch of civil engineering known as surveying, determining lines, plotting locations, and making maps therefrom.

Langley, Samuel Pierpont.—Born 1834, died 1906. An American scientist. He invented the bolometer, a sensitive instrument for measuring radiant energy, and other valuable apparatus for physical experiments; he made important astronomical observations at Pike's Peak and other places of great altitude, which added much to the knowledge of the phenomena of the heat radiation from the sun. Later he gave much attention to the problem of mechanical flight, carrying on extensive experiments with airships and soaring devices, until in 1897 he achieved a degree of success which justified his conviction that aerial navigation was a mechanical possibility.

Language.—Human speech; aggregate of sounds used to express perception and thought.

Lantern.—1. A kind of pinion; a lantern pinion or lantern wheel.

2. Something enclosing a light, and protecting it from wind, rain, etc.; sometimes portable; as, a closed vessel of perforated tin, glass, or other material, having a lamp or candle within; sometimes fixed; as, the glazed enclosure of a street light, or of a lighthouse light.

3. That which fastens the generating tubes into the headers in certain water tube boilers.

4. In calico printing, a contrivance to hold cloth when it is desired to fix the colors by the aid of steam.

Lantern Wheel.—A small gear wheel in which the teeth are replaced by round bars driven into two parallel discs. Such wheels are useful in making up the trains of turret clocks, etc., and in mill work. Also known as *trundle wheels*.

Lanthanum.—A rare metal belonging to the same group as aluminum.

Lanyard.—A piece of cord or line for seizing or fastening anything.

Lap.—1. That which lies over another part.

2. In a slide valve of a steam engine, the amount by which the admission edges overlap the steam port when the valve is in a central position, relative to the cylinder face. The effect of lap is to cause the steam to be cut off at a proportionately early period of the stroke, thus promoting expansion and consequent economy.

3. In cotton manufacture, the thin sheet in which the fiber is delivered to the carding engine, after scutching and beating. It has lost much of its dirt by beating and blowing, and has been pressed upon a wire gauze cylinder, which delivers it upon a roller.

Lapidary.—An artificer who cuts, polishes, or engraves gems or precious stones.

Lap Joint.—In boiler making, a riveted joint where the edge of one plate covers or overlaps that of the other to which it is to be united.

Lap Jointed.—Having joints formed by overlapping the edges of plates; as, in steam boilers, etc.

Lap of the Slide Valve.—1. In a steam engine, the lap of the slide valve on the steam side is the distance the outer or steam edge of the valve extends beyond, or laps over the outer or steam edge of the port when the valve is in its central position. It is given for the purpose of causing the engine to work expansively, by cutting off the admission of steam before the end of the stroke, and is called *outside lap*.

2. Also the lap which controls the exhaust and causes the passage to the condenser to be closed before the end of the stroke; the piston is then said to be *cushioned* by the elasticity of the confined vapor upon which it descends. This is called *inside lap*, and is the distance the inner or exhaust edge of the valve extends beyond or laps over the exhaust edge of the port when the valve is in its central position. Sometimes the inside lap is made zero or even *negative lap*.

Lapper.—In cotton manufacture, a machine which receives the cotton from the scutching and blowing machines, and presses it into a sheet or mass termed lap, for feeding into the carding machine.

Lapping.—A method of grinding interior and exterior surfaces in a lathe, by friction of lead cylinders or clamps supplied with oil and a fine abrasive powder. The method is used where it is necessary to obtain an exceedingly smooth and polished surface, as in the manufacture of ordnance.

Lapstone.—A stone for the lap, on which shoemakers beat leather.

Lap Streak.—Made with boards whose edges lap over one another, in distinction from being made with boards fitting edge to edge; as, a lap streak boat.

Lap Weld.—A scarfed weld in tubing, etc., in which one part is overlapped by the other.

Lap Welded Tube.—In pipe fitting, malleable iron tubes for steam and water pipes, are lap welded; that is, the plates overlap one another at their joints, instead of merely abutting at the weld.

Larboard.—The left hand side of a ship, when a person stands with his face to the head; port.

Lard.—The fat of swine, after being melted and separated from the flesh.

Lard Oil.—The oil expressed by gradual pressure and gentle heat, from lard or hogs' fat, leaving a white solid residue known as stearin, used in candle making. Lard oil is used in cookery, in preparing wool, and for lubrication.

Large.—Having great size, big, bulky; extended; great.

Large.—In rolling mills, a short piece of bar iron for rolling into a sheet; a small billet.

Larry.—A kind of hoe with an arched connection between the socket and the blade, used by masons for mortar mixing, etc.

Lash.—To tie or bind with a rope or cord; to secure or fasten by a string; as, to lash anything to a mast or to a yard; to lash a trunk on a coach.

Lasher.—A piece of rope for binding or making one thing fast to another.

Last.—1. A model of the human foot upon which footwear is formed.

2. A weight or measure of certain commodities, varying with the article and the locality; thus, a *last* of hides is 12 dozen; of codfish 12 barrels; of flax 1700 lbs.; the term is rarely used, or only locally.

Last Coat.—In a foundry, the smooth or finishing coat of loam applied to a loam pattern, mould or core.

Lasting Machine.—An implement somewhat resembling a pair of pincers, used in stretching the upper of a boot or shoe upon the last, so that it may be pegged down preparatory to soling.

Lat.—Abbreviation for latitude.

Latch.—A catch for a door, which may act by its own weight or by a spring.

Latch Dies.—The connecting catches or latches, in a Corliss valve gear, which engage the admission valves and the gearing and are tripped by the governing mechanism.

Latch String.—A string fastened to a latch and passed through a hole above it to the outside; used for lifting the latch, hence, the expression: "The latch string is out," meaning the door is always open; an assurance of welcome.

Lateen.—A triangular sail laced on the long side to a spar which is mounted on the mast in an oblique manner; a rig much used in the Mediterranean.

Latent Heat.—That quantity of heat which disappears or becomes concealed in a body while producing some change in it other than rise of temperature; as, fusion, or evaporation; the quantity being constant for each particular body and for each species of change.

Latent Heat of Steam.—Insensible heat; in heating water a certain proportion of the heat which has been absorbed, is not shown by the thermometer or by touch. There are two sorts or conditions of heat in the process of steam production operating upon water: (1) sensible heat; (2) latent or insensible heat; hence the constituent, or total heat of steam consists of its latent heat in addition to its sensible heat. In generating water into steam there is absorbed about five and one half times as much heat as is required under atmospheric pressure, to raise the temperature of the water from freezing point, 32° Fah., to boiling point, 212° Fah., an amount of heat which if the water were a fixed solid would, it is said, render it *red hot* by daylight. Tested by a thermometer the steam will show only 212°, but by experiment 965.7 heat units, have been added, which is stored up in some unaccountable way and is called the *latent* heat of steam.

Lateral.—Proceeding from or attached to the side; as, lateral force.

Lateral Motion.—That in a sidewise direction; a swaying movement.

Lateral Strain.—In mechanics, a strain which bears against the *sides* of a structure, being essentially a transverse strain.

Lath.—A thin, narrow slip of wood designed to be nailed to the rafters of a building, for the purpose of supporting the tiles or covering; a thin, narrow slip of wood to be nailed to the studs for the purpose of supporting the plastering.

Lathe.—1. A machine tool for shaping articles of wood, metal, or other material, by causing them to revolve while acted upon by a cutting tool held either by the hand or a slide rest; called also turning lathe. Lathes are named from some feature of their mechanism, mode of driving, etc.

2. In weaving, the swinging part of the loom which carries the reed for the warp threads, and drives the woof or filling up against the woven fabric. Also termed *batten*, *lea* and *lay*.

Lathe Carriage.—In machinery, the sliding piece that carries the *tool rest* of a lathe.

Lathe Center.—In machinery, the piece or part of a lathe which enters the coned recess of lathe work that is held between the centers.

Lathe Cheeks.—In machinery, the sides of a lathe bed.

Lathe Dog.—In lathes, a carrier or driver used to rotate the work held between the centers of a lathe; it is of varied form, the commonest being an eye, encircling the piece to be turned, fitted with a tail to engage the driving plate and a set screw to lock the work.

Lathe Drill.—A machinists' lathe, used or adapted for drilling. Called also drill lathe, drilling lathe and speed lathe.

Lathe Hoist.—A device for raising work to the centers of a lathe.

Lathe Planer.—In machinery, a piece of mechanism sometimes attached to a lathe, for the surfacing of metal by rectilinear cutting.

Lathe Saddle.—In machinery, the sliding piece that carries the *tool rest* of a lathe.

Lathe Shears.—In machinery, the sides of a lathe bed.

Lathe Tool.—Any tool used in the tool post of a lathe. They are named from their purpose; as, screw tool, or from their shape; as, hooked tool.

Lathe Work.—In machine shop practice, has reference to the work commonly accomplished in the lathe, which embraces practically almost all branches of lathe operations.

Latitude.—1. The width or breadth of anything; sidewise extent.

2. Extent within limits; scope or comprehensiveness.

3. The angular distance of any place measured north or south of the equator, along the meridian of that place.

Latterkin.—In painting and glazing, a pointed wooden tool used in glazing leaden lattice; as, ornamental windows for staircases, etc.

Lattice.—Openwork of wood or metal, formed by crossing or interlacing strips or bars; as, a lattice window or a lattice bridge.

Lattice Bridge.—In bridge building, a bridge supported by *lattice girders*, or lattice work trusses.

Lattice Girder.—A steel or wrought iron girder, made by uniting the top and bottom angle bars with diagonal bracing, resembling lattice work.

Lattice Truss.—A truss formed of an upper and lower chord, as in the Howe truss bridge, connected by lattice-like ties or braces.

Lattice Web.—A girder web made by latticing or crossing diagonals, as distinguished from one built up with plain triangles or a solid plated web.

Launch.—1. The largest boat belonging to a warship.

2. A large open boat propelled by steam, naphtha or electricity.

3. To slide a vessel into the water.

Launching.—Moving or causing a vessel to slide into the water.

Launching Ways.—The well greased squared beams laid under a ship's bottom keel and bilge, on which she slides into the water.

Launder.—In mining, a trough or gutter to lead water or fluid matter in a desired direction.

Laundry Machinery.—Apparatus employed in washing, drying, mangling and ironing clothes, linen, etc., by the aid of power.

Lava.—1. Molten rock ejected from a volcano.

2. The same when cooled and hardened.

Lavas vary much in structure and texture; some are composed entirely of obsidian or volcanic glass, while others are masses of interlaced crystals. Generally speaking, a lava has a glassy matrix in which crystals are embedded. Some are compact while others are very cellular, the specific gravity ranging from 2.37 to 3.22, the heavier containing iron, etc.

Law.—In science, a law is the statement of the results which follow from the operation of certain specific natural causes. It may be deduced from experiment and calculation, or may be inferred from observations of events.

Lawn Mower.—A machine for cutting grass, consisting of a revolving cylinder, armed with spiral knives which rotate in contact with the edge of a stationary knife.

Laws of Heat.—Heat is transmitted in three ways: (a) by conduction, as when the end of a short rod of iron is placed in a fire, and the opposite end becomes warm, this is conducted heat; (b) by convection, such as the warming of a mass of water in a boiler; and (c) by radiation, as that diffused from a piece of hot metal or an open fire. Radiant heat is transmitted, like sound or light, in straight lines in every direction, and its intensity diminishes inversely as the square of the distance from its center of radiation.

Laws of Thermodynamics.—In physics, the rules of the science which treats of the mechanical action or relations of heat.

Lay.—1. To place in order; to arrange with regularity; to dispose in ranks and tiers; as, to lay bricks or stones in a wall.

2. In weaving, a swinging frame in a loom, called also the batten or lathe, by the movements of which the weft threads are laid parallel to each other against the cloth previously woven.

Layer.—1. That which is laid; a stratum; a body spread over another; as, a layer of clay or of sand; a course; as, of bricks and the like.

2. In paper making by hand, the workman who takes the post of paper and felt, after pressing, arranges the paper alone in "packs," when it undergoes a second pressing, and after being parted sheet from sheet, is again pressed a third time.

Laying.—In plastering, the first coat of plaster in two coat work. In rope making, the twisting of strands into a rope.

Laying Off.—A shop term; if a man remains away from work a few days, or the employer informs his help to stay at home for a short or long period, or has no more work for them, it is termed *laying off*. Incompetence or bad behavior being the cause of dismissal, it is called a *discharge*.

Laying Out.—1. The method or process of arranging a scheme of work so that the processes shall follow one another in due order.

2. The act of scheming the arrangement for a plant installation so that the desired end may be best attained.

3. The operation of lining out or marking off work so that the center and working lines of forgings and castings may be set off for the machinists. This is best done by special men at the *surface plate* or *marking off bench*, ensuring uniform practice.

Layout.—The general arrangement of anything, as a works or plant; the method of carrying on operations; the scheme or system planned for effecting any desired result.

Lay Race.—In weaving, the shuttle path on the lay of a loom; also called the *shuttle race*.

Lay Shaft.—A second motion shaft; in an automobile, a secondary shaft driven by a sliding gear; change speed mechanism.

Lay To.—To arrest the motion of a ship by bracing her yards or stopping the engines, without making fast or anchoring.

Lazaretto.—1. The space below decks in the after end of a ship for stowing provisions, etc.

2. A hospital, generally for infectious diseases.

Lazy Bar.—In steam engineering, an appliance sometimes used in connection with slice bars and pokers. It is a hook shaped iron, attached above the furnace door, so that it supports the principal part of the weight of the heavy slice bar or poker when being used in cleaning out the fires.

Lazy Tongs.—A system of jointed bars, originally made for picking up something at a distance, now variously applied in machinery.

Lb.—Abbreviation for pound; plural, lbs.

Lea.—1. In weaving, one of the sets into which the warp threads are divided by the harness; the set of warp threads passing through any particular heddle.

2. A scythe.

Leach.—1. To wash or drain by percolation of water, or to remove by percolation; as, to *leach* potash from wood ashes.

2. A separation of lye, the result of a process of leaching.

3. The straight or sloping vertical edge of a sail; in a fore and aft sail the after edge only, the forward being termed the *luff*. In this sense sometimes written, *leech*.

Leach Brine.—In salt making, brine that drops from granulated salt while drying, and is subjected to further drying.

Leach Track Sander.—An attachment to a locomotive sand box, whereby a jet of compressed air from the brake system is utilized to blow sand down the pipe, thus ensuring its more efficient distribution between the wheel tread and the rail.

Lead.—1. To be in advance of; to show the way to; to be in the front or be first in anything.

2. A lustrous, blue gray metal, soft enough to be cut with a knife or to leave a mark on a piece of paper: it is malleable and ductile but is not a good conductor of heat and electricity as compared with other metals. Its specific gravity is 11.2, a cubic foot weighing 698 lbs.; its tenacity is about 2800 lbs. per square inch, as wire.

3. In a steam engine, the amount of pre-admission given by the slide valve at the instant the piston is ready to commence its impulse stroke. The amount varies and depends upon the type of engine and the angular advance of an eccentric before its crank.

Lead Burning.—A process of soldering in which the edges of lead plates are burnt together by means of a hydrogen flame, in conjunction with compressed air. Much used in acid works, as the tin of solder is eaten away by most acids.

Leaded Lights.—In architecture, the term applied to those windows that have their panes set in leaden strips; as, *stained glass windows*.

Leaden.—Made or composed of lead; as, a leaden pipe.

Leader.—1. A pipe to carry water from the roof or upper part of a building to the ground.

2. A principal wheel in any kind of machinery; a master wheel.

3. In milling, a furrow from the eye or bosom of a millstone to its skirt, called also *leader furrow*.

4. In mining, the indication of metal which the miner follows in his work when the course of the vein is not well defined or regular.

Leaders.—In furnace heating, the hot air pipes running horizontally from the furnace to the vertical pipes.

Lead Hammer.—A hammer with a head of cast lead used for striking polished work. In engineering work, it is customary to employ hammers of copper, white metal or babbitt and lead, thus affording various degrees of hardness according to the strength of the blow required to be struck.

Leading Block.—A block for guiding a rope, as a purchase, or for hauling an end, out of a direct line.

Leading Edge.—In marine engineering, that edge of the blade of a screw propeller, which cuts the water, as distinguished from the edge that follows.

Leading Hand.—A shop term for the workman who by reason of his superior

skill occupies a leading position, to whom the orders are given and who is held responsible, more or less, for the men under his charge.

Leading Rolls.—In paper making, the guide rolls for the wire, the traveling endless felts and web of the paper machine.

Leading Screw.—In a lathe, the screw which is driven by the change wheels at a determined ratio of speed to the mandrel, and into which the nut on the slide rest may be engaged, thus giving the proper rate of feed for screw cutting.

Leading Spring.—In railway engineering, the springs which carry the axle boxes of the leading wheels of locomotives and rolling stock, and which sustain and minimize the shock due to concussion. They usually consist of about sixteen steel plates of about $15 \times \frac{1}{4}$ inch section, the largest being thicker, or say $\frac{1}{2}$ inch.

Leading Wheel.—In a locomotive, a wheel that occupies a position in front of the driving wheel.

Lead Joints.—In pipe fitting, lead joints are used in pipe connections. Sometimes a sheet of lead is screwed up between flanges, but the employment of the metal is more common in *socket and spigot* joints. The lead is poured between the socket and spigot and hammered or stemmed down; that is, driven closely home with a drift and hammer.

Lead Line.—1. The line attached to a sounding lead.

2. In a steam engine indicator, the left hand vertical line on the diagram which represents the amount of opening to lead. Also called the *pre-admission line*.

Lead of Valves.—In steam engines, the amount by which a slide valve has uncovered the port to steam, when the piston is at the beginning of the stroke.

Lead Poisoning.—Disease or poisoning occasioned by the introduction into the system of some preparation of lead; this is liable to attack white lead burners, painters, plumbers, file cutters, etc. The symptoms are painter's colic, rheumatism, palsy, etc.

Leads.—1. A roof covered with sheet lead; the guttering, flashings and other parts of a roof protected by sheets of lead.

2. In printing, thin metallic slips used for separating lines.

Lead Screw.—An accurate lengthwise screw on a lathe, for moving the tool carriage regularly lengthwise.

Leadsman.—In a ship, the individual who sounds or throws the lead and ascertains the depths of water

Lead Tempering.—In metal work, a method of tempering. For heating many classes of cutlery preparatory to hardening, a bath of melted lead, or an alloy of lead with tin is used. The advantage is that the temperature of such a bath is uniform and therefore more reliable than the test of color. By varying the proportions of lead and tin, the temperature of the bath can be varied within a range of more than 200° Fahr.

Leaf.—In founding, a special form of sleeking tool, shaped like the lanceolate leaf of a shrub. In tapestry weaving, one of the two sets or halves into which the warp threads are divided and placed behind one another.

Leaf Spring.—A plate or laminated spring to support a vehicle.

League.—A measurement of distance, equaling three statute miles.

Leak.—The oozing or passing of water, or other fluid or liquor, through a crack, fissure, or aperture in a vessel, either into it; as, into a ship, or out of it; as, out of a cask.

Leakage.—The loss of water or other fluid from any cause.

Lean-to Roof.—A roof which lies on one uniform slope, instead of forming an angle or gable. Such roofs are common on extensions of a house, but some districts adopt them for all ordinary dwellings.

Lea Rod.—In weaving, one of the rods securing the dents of the reed in the loom. Also known as *lay rod*.

Lease.—1. In weaving, the tie around each band of the *warp* as arranged by the *heck*. The word is equivalent to *lash*, a tie, and forms a guide for the weaver in setting the warp in the loom, and inserting the lease rods.

2. To grant to another the possession of land or buildings under consideration of a yearly or monthly payment; as, the lease of a factory or any industrial plant.

Least Common Multiple.—In arithmetic and algebra, the least number containing the whole of a series of other numbers, as factors. Thus, 24 is the L. C. M. of 12, 8, 6, 4, 3 and 2, because it is the *lowest* number containing *all* those factors.

Leat.—A channel for water dug on the ground level; it differs from the *launder* in that the latter is an artificial conduit carried at a slight elevation above the ground.

Leather.—The skin of an animal converted into a durable and non-decaying substance, which is soft and supple for certain uses, firm and hard for others. There are three main processes: (1) impregnation of the hide or skin with tannic acid which combines with the gelatine to make an insoluble substance, this being used for sole leathers and the like; (2) treatment with alum or other mineral salts; as, for glove skins; (3) treatment with oils and fats; as, for chamois skins (*shamoying*). Heavy leathers are also tanned with *chrome*, principally for belting, boot uppers and heavy harness.

Leather Belting.—A material widely used for driving machinery. It is used single or double, sometimes treble for a main drive, the thickness of each single strip ranging from $\frac{1}{8}$ inch to $\frac{3}{8}$ inch. The strips are spliced, cemented, or sewn together to make up the necessary length and width, and are finally united at the ends by lacing or riveting. The ultimate stress of leather belting is 3000 to 5000 lbs. per square inch of section. For a single belt the usual working load is 33 lbs. per inch of width.

Leather Hollows.—In pattern making, strips of leather largely used by pattern makers to form the hollows in wood patterns. The reason why they are preferred to hollows made of wood is that the time occupied in laying them around curved portions of work is much less than that occupied in cutting wooden hollows.

Leathers.—In hydraulics, cup or hat leathers as used in pumps or hydraulic presses.

Leather Wheels.—Leather covered polishing wheels, as used in buffing or polishing metals.

Leavings.—1. Things left; remnants.
2. Refuse; offal.

Ledge.—1. In architecture, a small moulding, as the *Doric drop ledge*.

2. In carpentry, a piece against which something rests; as, the batten on the back of a door, the fillet against which a door closes, etc.

3. In mining, a stratum of metal bearing rock.

4. In shipbuilding, a piece in the deck framing. Also called *shelf piece*; a support for the decks, parallel to and intermediate between the beams, also called *head ledge*.

5. In civil engineering, a shelf, ridge or reef of rocks.

6. In carpentry, a shelf on which articles may be laid; also that which resembles such a shelf in form or use; as, a projecting ridge or part, or moulding or edge in trimming.

Lee.—The sheltered side; that away from the direction whence the wind is blowing; opposite to windward.

Leeward.—The direction to which the wind blows; the opposite of windward.

Leeway.—In navigation, the distance which a ship is driven from her direct course by wind or tide. Thus, if a ship travels due west at 10 miles an hour, and the weather carries her 1 mile to the southward during each hour, at the end of 24 hours she will have gone 240 miles west and 24 miles south.

Left.—1. Situated on the left hand side or upon the side to which a person's left hand is supposed to be turned; the side opposite to the right; as, the left bank of a river is that on the left of a person going down stream.

2. Departed; remaining after any operation.

Left Hand.—1. A term applied to many objects as a classification to denote their arrangement, position or motion.

2. Said of an engine, when the fly wheel is upon the left hand side looking from the cylinder.

3. Opening towards the left from the far side of the jamb; as, with a door.

4. In a saw bench, having the circular saw upon the left hand side of a person, towards whom the top edge is running.

5. Said of a rope when the strands are laid up similarly to the thread of a left hand screw, the reverse of the usual method.

Left Hand Engine.—In steam engineering, an engine having its fly wheel to the left when viewed from the end of the cylinder.

Left Hand Screw.—In machinery, a screw which enters in turning from right to left; i. e., counter clockwise.

Left Hand Thread.—A helix, or spiral, whose turns, when viewed sidewise, curve from left to right in their course from the bottom to the top, necessitating a counter clockwise turning movement when entering a nut: both motions being the reverse of those with the ordinary thread.

Left Hand Tools.—Side tools ground to an angle on the right hand side, and which, therefore, cut from left to right.

Leg.—1. That which resembles a leg in form or use; especially any long and slender support on which any object rests; as, a leg of a pair of compasses.

2. An extension of a steam boiler, of the locomotive type, downward, in the form of a narrow space between vertical plates, sometimes nearly surrounding the furnace and ash-pit and serving to support the boiler; also called *water leg*.

3. In a grain elevator, the case containing the belt which carries the buckets.

Leg Vise.—A bench vise of the ordinary pattern with a vertical leg or strut supporting it from the floor.

Lemma.—Something which is premised, or demonstrated, in order to render what follows more easy.

Length.—The longest, or longer, dimension of any object; as distinct from breadth or width; extension of anything from end to end; the longest line which can be drawn through a body parallel to its sides.

Lengthen.—To extend in length; to make longer in extent; as, to lengthen a line or road.

Lengthening Bar.—An appendage to compasses used for drawing purposes. It is a brass leg or shank which is made to fit into the socket of the compass leg at one end, and also over the stem of ink or pencil point at the other; its purpose being the adaptation of the compass to the measurement of long distances, or the striking of arcs of large radii.

Lengthwise.—In the direction of the length; in a longitudinal direction.

Lens.—In optics, a piece of glass, or other transparent substance, ground with two opposite regular surfaces, either both curved, or one curved and the other plane, and commonly used, either singly or combined, for changing the direction of rays of light, and thus magnifying objects, or otherwise modifying vision.

Less.—Not so much; a smaller quantity.

Lessen.—To make less; to reduce; to make smaller.

Lesson.—Anything read or recited to a teacher by a pupil or learner; something, as a portion of a book, assigned to a pupil to be studied or learned at one time.

Let In.—A shop term, which signifies the sinking in of one portion of wood or metal into another. Thus, rapping plates are *let in* to patterns, brass rings are *let in* to sluice cocks, faces, etc.

Let Off.—In weaving, an arrangement in a loom by which the yarn is paid off from the beam at such a rate as required.

Letter.—1. A writing; an inscription.

2. A mark or character used as the representative of a sound or of an articulation of the human voice.

3. A written or printed communication; an epistle.

Lettering.—In mechanical drawing, the delineation of letters, figures and other characters for purposes of explanation or to denote parts and measurements.

Levee.—An embankment to prevent an overflow; as, the levees along the Mississippi.

Level.—1. Lying in a horizontal line or plane.

2. The average elevation of a certain place, as sea level.

3. The altitude or elevation of a definite spot, as compared with some standard or datum line, generally the mean level of the sea.

4. An open channel along which water flows.

5. A horizontal excavation in a mine or along the course of a vein of ore.

6. A surveying instrument for determining the relative heights of two points. It has a telescope capable of accurate horizontal adjustments, and mounted upon a tripod stand. The level is used in conjunction with a graduated staff, which is held vertically on various successive stations. The marks on the staff which coincide with the cross wires of the telescope at each point, are carefully observed, and their difference corresponds to the difference in elevation of the various points.

7. In mining, a more or less horizontal passage in a mine.

Leveling Block.—In boiler making, a large flat cast iron plate, stiffened on its under side with flanges or ribs, upon which plates of sheet iron and steel are laid while being leveled. It is used by boiler makers and platers.

Leveling Screws.—In surveying, etc., adjustable screws fitted to the supporting feet of various instruments and appliances, so that they may be set in an even position.

Leveling Staff.—1. A graduated rod or staff for measuring differences of level between points where it is set up, by means of the different positions of the slide or target upon it, when set to the line of sight of the leveling instrument.

2. In milling, the adjusting of the grinding millstones.

Lever.—A bar of metal, wood, or other substance, used to exert a pressure, or sustain a weight, at one point of its

length, by receiving a force or power at a second, and turning at a third on a fixed point called a fulcrum. It is usually named as the first of the six mechanical powers.

Leverage.—The mechanical power gained by the employment of the lever.

Lever Feed.—Said of a machine in which the tool is fed to the work by pressure on a lever instead of the usual method of spur or worm gearing acting on a screw.

Lever Jack.—In machine shop work, a form of jack comprising a simple lever for lifting, and a standard for support.

Lever Press.—In machinery, a form of press used for compression of substances for export, as of cotton goods into bales, and other purposes. It is acted upon by a long lever.

Lewis.—In stonework, a device for lifting blocks, in which two wedge shaped pieces are inserted in a dovetailed recess, centrally disposed, and locked by a center tongue piece. The whole is fastened with a shackle or chain, so that the lewis wedges itself tight on the dovetail in lifting.

Lewis Bolt.—A bolt for securing into stonework, similar to the lewis, having a pyramidal head, which is permanently fastened in the dovetail by pouring melted lead around it.

Lewis Plug.—A device for lifting stones, consisting of a tapering plug fitted into a slightly larger conical hole over the center of gravity. A key is driven in between the plug and the circumference of the hole, holding all tight under strain, but released by a downward tap when the block is landed.

Ley Chain.—A driving chain composed of interchangeable and detachable links of malleable cast iron; *link belting*, the pioneer in the use and production of this material.

Liability.—The state of being liable; as, the liability to accidents; liability to the law.

Liable.—Exposed to a certain contingency or casualty more or less probable; as, liable to slip.

Lib.—Abbreviation for library, or librarian.

License.—An official permit to do something. A document giving the consent of the proper authorities to carry on certain businesses, to deal in certain commodities or to fill certain positions, all of which are placed under some restriction either for purposes of revenue or for the general safety; as, an engineer's license.

Licker In.—In manufacturing, a drum with cards on its periphery presented at the throat of a *carding machine*, so arranged as to catch or lick in the cotton filaments as they are presented by the passage of the *lap* between the feed rollers.

Lid.—That which covers the opening of a vessel or box.

Lie.—The position or way in which anything lies; the lay; as, of land or country.

Lie To.—In navigation, to stop or delay; especially, to head as near the wind as possible as being the position of greatest safety in a gale.

Life.—1. In mechanics, the period of time during which an object may be kept in actual use.

2. The number of separate times which an object may be used that is designed to be employed intermittently only.

Life Belt.—In marine service, a belt of cork to fasten around the body, and hollowed out under the arms.

Life Boat.—In life saving stations, etc., a boat fitted with air tight chambers by which it is rendered especially buoyant.

Life Buoy.—A contrivance of cork or other material, to sustain persons in the water; legally it must be capable of floating for 24 hours, supporting 32 lbs. of iron.

Life Line.—A temporary line fixed as a support; as, ropes passed through standards around an open hatchway, or guard lines along a deck in heavy weather, when seas are breaking over a ship.

Life Raft.—A seat or platform carried on a steamer's deck, constructed to float and support a number of persons in case of disaster.

Life Saving Apparatus.—A term usually applied to the rocket apparatus, whereby a line is thrown across a

stranded vessel from the shore by means of a rocket or a barbed projectile thrown from a cannon. On hauling upon the line, a cable is pulled out to the vessel and secured at either end to the rigging and to a crotch ashore. By pulling on the hauling line, a breeches buoy or a life car is made to travel backwards and forwards between the wreck and the shore; in the first case the passengers are landed singly, in the latter they go by threes or fours.

Lift.—1. To move in a direction opposite to the law of gravitation; to raise; to elevate.

2. The space or distance through which anything is lifted; as, a long *lift*.

3. A hoisting machine; an elevator; a dumb-waiter.

4. In mechanics, one of the steps of a cone pulley.

5. In mining, a single set of pumps in the shaft; each combination of pumps and cistern, of which a series are used to conduct the water to the surface.

6. In pumping, that portion of the *total head* represented by the difference in elevation of the water to be pumped and the inlet of the pump.

Lift and Force Pump.—One which sucks or lifts the liquid to be pumped, and delivers the same under pressure. To effect this, some sort of piston or plunger pump is necessary.

Lifter.—A moulder's dressing tool, having a square blade at right angles to the stem, used to lift detached portions of sand from the mould.

Lift Hammer.—An old fashioned smith's hammer, which is lifted by a spring pole overhead, and depressed by the placing of the workman's foot on a treadle. The hammer, the overhead pole and the treadle are alike connected to a pivoted horizontal bar of wood.

Lifting Cylinder.—In machinery, the cylinder of a hydraulic crane, which is used for lifting the load, as distinguished from the *turning cylinder*. There are in the largest cranes, three such cylinders, by means of which, when worked separately, or in unison, different degrees of power can be exerted.

Lifting Gear.—The casing gear whereby a safety valve is lifted from without; its use is to blow off steam when the pressure requires to be reduced for any reason.

Lifting Jack.—A screw, ratchet or hydraulic jack, designed to raise heavy weights.

Lifting Rod.—In steam engineering, a rod receiving motion from the rocker

shaft, and imparting motion to the lifter of the poppet valve.

Lifting Screw.—In founding, a rod screwed into the pattern to lift it from the mould.

Lifting Shaft.—In a locomotive, a term applied to the reverse shaft or weigh bar.

Lifting Valves.—Those in which the disc or cone is lifted vertically from the seat, by pressure from below, as in *safety valves*. Also poppet or double beat valves which have vertical motion.

Light.—1. To become ignited; to take fire.

2. Not burdensome; easy to be lifted, borne, or carried by physical strength; as, a *light* burden or load.

3. That agent in nature, by the operation of which objects are rendered visible.

Light Cut.—In metal work, a cut is said to be *light* when the shavings removed are thin and narrow. But a cut which would be a light one when taken off a large piece of metal, would be a heavy one if taken off smaller work.

Lighter.—A barge or scow used to transport merchandise, etc., to and from vessels at anchor, in places where there is no wharfage accommodation, or where the water is too shallow for large craft to pass. The latter case gives rise to the name, as by this means a ship is often *lightened* sufficiently to cross a bar.

Lighterage.—The charges made for the use of lighters or for the transport of cargo by their means.

Light Firing.—In steam engineering, the making up of a thin fire, caking it on the dead plate, and frequently renewing the charges.

Lighthanded.—Not having a full complement of men; as, a vessel *lighthanded*.

Lighthouse.—A tower, generally of stone, but sometimes of iron, which exhibits a powerful light, controlled by proper machinery, so as to give its rays a characteristic distinguishable appearance. Lighthouses serve to warn mariners of dangers near and act as range marks whereby to set a proper course.

Lighting of a Furnace Fire.—When quite certain that everything is in proper condition, put a good armful of shavings or fine wood upon the grate, then upon this some larger pieces of wood to form a bed of coals, and then a little of the fuel that is to be used while running.

When the fire is well ignited, throw in some of the regular fuel, and when this is burning add more, a little at a time, and continue until the fire is in its normal condition, taking care, however, not to let it burn too freely for fear of injury to the sheets by too rapid heating.

It is usually more convenient to light the fire through the fire door, but where this cannot be done, a torch may be used beneath the grates, or even a light fire of shavings may be kindled in the ash pit.

At the time of lighting, all the draughts should be wide open.

As soon as the steam is *seen* to issue from the open upper gauge cock it is proof that the air is out. It should now be closed and the steam gauge will soon indicate a rise in pressure.

When the steam begins to rise it should next be observed that: 1. All the cocks and valves are in working order—that they move easily. 2. That all the joints and packings are tight.

Lightning Rod.—A metallic rod set up on a building or on the mast of a vessel and connected with the earth or water below, for the purpose of protection from lightning.

Light Running.—In machinery, a wheel and axle, a lathe crank, an engine shaft, or journal of a shaft, are said to *run light* when there is the minimum of friction, due to good bearing surface, good fitting, and proper lubrication.

Lightship.—A staunch craft, anchored in a suitable position, to exhibit signal lights; generally used where it is impracticable to erect a lighthouse, as off river mouths.

Lignite.—In mining, mineral coal retaining the texture of the wood from which it was formed, and burning with a disagreeable odor; called also *brown coal* and *wood coal*.

Lignum Vitæ.—A wood found in Cuba, Jamaica and San Domingo. It is of a dull, brownish green color, hard, and close grained; the fibers interlacing at various angles. The heart wood is chiefly used, and its uses in engineering are for the linings of the shaft bearings of propeller screws, and turbines which work in and are lubricated by water only. It is also greatly used for making of mallets, etc. A cubic foot weighs from 40 to 80 lbs.

Limb.—1. A part of a tree which extends from the trunk and separates into branches and twigs; a large branch.

2. A thing regarded as a part or member of, or attachment to, something else.

3. An elementary piece in the mechanism of a lock.

4. The graduated sector or semi-circle resembling a protractor, furnished to theodolites, transits and surveying instruments generally.

Limber.—Easily bent; flexible; pliant; yielding.

Lime.—Oxide of calcium; the white, caustic substance, usually called quick lime, obtained from limestone, shells, etc., by heat, the heat expelling carbonic acid and leaving the lime behind.

Lime Bag.—In a foundry, a linen or muslin bag containing lime powder used for dusting on the lower joint faces of foundry moulds and over the tops of cores before lowering on the top part of the flask. The lime touches and leaves an impression on the upper mould face if the joints are close, but non transfer of the lime indicates openness of the joint, which the moulder investigates and corrects.

Lime Kiln.—A kiln or furnace in which limestone or shells are exposed to strong heat and reduced to lime.

Lime Light.—An application of the intense heat of a hydrogen flame to produce light. A jet of burning hydrogen, in combustion with another of pure oxygen, is directed upon a cylinder of lime, whose particles are raised to such a high temperature that they become incandescent and emit a dazzling white light.

Lime Plaster.—A compost of quicklime, sand and hair, used for interior plaster work. Three coats are employed: the *scratch coat*, rich in lime with plenty of hair, which is scored or scratched after hardening, so that the other coats shall adhere; the *brown coat*, largely consisting of sand; the *white or skim coat* of lime, putty and fine white sand, put on with a trowel and floated down.

Lime Putty.—After slaked lime has stood several days, the water evaporates and the lime thickens to a heavy paste, resembling putty. This lime putty may be kept for an indefinite time without deterioration, if care be taken to keep it in the vessels in which it was slaked, and covered with sand, so that it shall not dry up. The putty is used in making white or colored mortars for face work.

Limestone.—A kind of stone consisting largely or chiefly of carbonate of lime, from which lime is obtained by the expulsion of its carbonic acid. Limestone is much used as a building stone, but most frequently is calcined in lime kilns, in which the carbon dioxide is driven off, and the oxide of calcium, an alkaline earth termed quick lime remains. This is used to a great extent in manufactures and the arts. For use as mortar it is "slaked" with water, which it absorbs with avidity, accompanied by an increase in volume, and the liberation of heat. When subjected to

the action of chlorine gas it becomes calcium chloride, used as a bleaching and oxidizing agent and a disinfectant. Lime is used for numerous other purposes in which a cheap and active base is desired. The rock is also used as a flux in smelting iron.

Limewhite.—Whitewash; a mixture of quicklime and water, used for rough painting, especially in places where a frequent application is necessary. It may be improved for holding on metal by adding 1 lb. of tallow to 10 gallons of wash, or may be made weather proof by adding 12 lbs. of salt to the same quantity.

Liminate Roller.—In a rolling mill, the adjustable roller whereby the thicknesses of rolled metal sheets are regulated.

Liming.—1. In leather manufacture, the removal of hair, from hides and skins, by soaking in a mixture of lime and water.

2. In sugar making, the process of purifying the syrup by means of the addition of lime and water, which removes the impurities in a scum.

Limit.—That which terminates, circumscribes, restrains, or confines; the boundary, border, or edge.

Limitation.—Restriction; the condition of being limited, or circumscribed.

Limit Gauges.—Double ended gauges, those for external work being stamped "go on" or "not go on" at either end, those for internal work bearing the lettering "go in" and "not go in"; the two ends are also of different shape for easy recognition. Each end is made to a certain allowance, above or below the nominal standard size according to the degree of finish required, thus fixing the limits of the variation between the maximum and minimum sizes of a hole or shaft. By their use, the time spent in gauging and measuring is reduced to a minimum, and interchangeable work is easily produced, the limits of variation being easily controllable.

Limousine.—1. A type of automobile in which the body of the coach is partly enclosed.

2. In civil engineering, a slimy, thick, muddy deposit on river bottoms, where the tide allows the same to be exposed to the air at intervals.

Lin.—A pool or collection of water, particularly one above or below a fall of water; a waterfall or cataract.

Linchpin.—A pin used to prevent the wheel of a vehicle from sliding off the axletree.

Line.—That which has extension in length only. The extremities of lines are points.

Lineal.—Belonging to lines, or measurements of length only: the state of being in a line.

Lineal Foot.—Involves measurement in one direction. Twelve inches equal one lineal foot.

Linear.—Appertaining to measurements in one dimension only; anything attributive to lines. *Lineal* and *linear* are generally used interchangeably in physics, but a certain differentiation is made; thus, we speak of a *lineal* foot, but of *linear* measure; *linear* accuracy, but *linear* observation.

Linear Expansion.—The longitudinal expansion of any body due to increase of temperature.

Linear Perspective.—In drawing, that branch of perspective which considers only the positions, forms and dimensions of the various objects represented, without regard to the variations in light, shade, and color due to their different distances and their varying illumination; these last qualities being regarded in *aerial perspective*.

Lineman.—A man employed to examine the rails of a railroad to see if they are in good condition; a man employed to repair telegraph lines; also, one who carries the line in surveying, etc.

Linen.—A fabric woven from the fibers of flax.

Linenprover.—In weaving, a microscope used in counting the threads of linen to determine the fineness of the material.

Line of Dip.—In mining, a line in the plane of a stratum, or part of a stratum, perpendicular to its intersection with a horizontal plane.

Line of Force.—In physics, the straight line in which a force acts.

Liner.—1. In steam engineering, the bush of a pump barrel or cylinder; as, of an engine.

2. In machinery, a thin strip of metal, leather, or wood placed between parts of machinery in order to permit of the taking up of their wear, and generally to permit of exact adjustment or better bearing. Liners are put under brass bearings to raise them up, and thus compensate for the lowering down due to wear.

3. In mechanical engineering, the wearing surface of friction clutches are sometimes lined with copper.

4. In steam engineering, liners are inserted between the feet or flanges of eccentric rods in the operation of valve setting. Marine engine propeller shafts are provided with brass liners where they run through the stern bush.

Line Shafting.—Shafting arranged in a line; as, in a factory, taking its power from one point and distributing it by means of belts and pulleys to the various machines on either side of its length.

Line Space.—In typewriting, printing, etc., the vertical arrangement or spacing of the lines: the "pitch" of a line.

Lining.—1. An internal surface provided for any object, especially when it is of different material to the exterior. It is usually something applied to prevent wear or deterioration; as, the lining of a garment; or is designed to prevent the transference of heat or the passage of a fluid or to resist certain actions; as, the fire brick lining of a furnace, the lead lining of an acid tank, or the pitch lining of a wooden cask.

2. The art of drawing fine lines of a contrasting color for purposes of ornamental effect; as, in carriage painting. When these lines are over a certain width, the process is frequently known as *stripping*.

3. The act of setting in line or aligning; as, in setting up or adjusting machinery; as, "lining up" a shaft.

Link.—1. One of the rings or separate sections of which a chain is composed.

2. That which connects any one thing or part with another, or any individual member of a connected series forming a continuous whole.

3. A bar with an eye at either end, or its equivalent, used to connect one part of a mechanism with another; especially used, when without qualification, to denote a coupling link for use with railway vehicles.

4. A curved bar of various patterns, or a slotted piece of metal, which forms the characteristic feature of most reversing valve gears, as in the Stephenson link motion it is curved to the radius of the eccentric rods, and connects their ends; being altered in position, by means of the hangers attached to the reverse shaft, it brings either rod wholly or partly into operation.

Link Belting.—In power transmission, is composed of a number of short links, arranged parallel and retained in position by pins which permit the links to pivot freely, and bend round small pulleys and transmit power easily between those which are situated at a short distance apart; being more flexible than continuous belting.

Link Lifter.—In railway engineering, a bar by which the link is raised or lowered, having its upper end pivoted to the end of the reverse shaft arm, and its lower end to a link saddle by means of the link saddle pin. On locomotives, having a transmission bar, by means of which the link block

moves the rocker, the lifters are often made double, one on each side of the link. Called also a *link hanger*.

Link Motion.—In a steam engine, a collective name for the arrangement of eccentric rods, link, hangers and rocking shaft, by which the relative position and motion of the slide valve are changed at will, thus providing for either forward or backward motion, with varying rates of expansion of the steam.

Link Saddle.—A plate, bolted to the side of a reversing link, and carrying a pin which affords attachment for the suspension link or hanger.

Link Work.—1. Machinery, in which links, or intermediate connecting pieces, are employed to transmit motion from one part to another; as, in grain conveying and elevating devices.

2. In blacksmithing, a fabric consisting of links made of metal fastened together; also, a *chain*.

Linoleum.—An artificial floor cloth or oil cloth, a preparation of linseed oil which is hardened by an oxidizing process, as by exposure to heated air, or by treatment with a sulphur chloride, and used as a substitute for india rubber. When mixed with ground cork and pressed upon canvas, it is used as a floor cloth.

Linotype.—A machine for producing stereotyped lines or bars of words, etc., as a substitute for typesetting.

Linseed Oil.—An oil, expressed from the seeds of the flax plant, used largely in the arts. Raw linseed oil is obtained by steaming the seeds before pressing; boiled oil is made by boiling the oil with litharge or sugar of lead, giving it a darker color and quickening its drying action.

Lint.—In weaving, fine ravelings, down, fluff, or loose short fibers from yarn or fabrics; also, linen scraped into a soft mass and used in dressing wounds.

Lintel.—The horizontal top piece of a doorway or window opening; any horizontal beam resting at both ends on vertical supports.

Lip.—The sharp cutting edge on the end of an auger; a thin projecting part of anything.

Lip Drill.—A flat drill whose cutting edges are curved forward, forming a *lip*; this is made during forging or is formed by grinding.

Liq.—Abbreviation for liquid, liquor.

Liquation.—1. The act or process of melting, or of becoming liquid.

2. In metallurgy, the separation of one metal from another by fusion.

Liquefaction.—The act or process of liquefying or reducing to a liquid state.

Liquefaction of Gases.—All gases become liquids under sufficiently high pressure, and low temperature. While gases or vapors are being compressed, the work expended on compression appears as heat, and this heat has to be removed before liquefaction takes place.

Liquefy.—1. To become liquid.

2. To make liquid, either by melting a solid or by compressing a gas.

Liquid.—Anything which flows and can be poured in drops, like water; it differs from a *fluid* in that the latter flows in a stream or streams, as a gas. Another definition is that a liquid flows, and wets that on which it flows.

Liquid Air.—A dry colorless liquid obtained by subjecting atmospheric air to great pressure and abstracting its heat.

Liquid Fuel.—Generally crude petroleum or its products, introduced into the furnace in a finely subdivided state, producing an intense heat with clear flame. It has the advantages of cleanliness, close stowage, easy handling through pumps and pipes, besides a greater thermal efficiency, weight for weight, than coal.

Liquid Measure.—A measure or system of measuring liquids, by the gallon, quart, pint, gill.

TABLE.

4 gills (gi.)	make 1 pint,	pt.
2 pints	1 quart,	qt.
4 quarts	1 gallon,	gal.

Liquor.—1. Any dilute solution used in manufactures.

2. In gas making, ammoniacal water condensed from the gas or produced in the scrubbers, subsequently recovered from the tar by distillation.

3. A dye or mordant in solution.

4. A solution of sugar used in sugar making to finish the loaves.

5. The tanning solution or ooze in which hides are steeped.

6. In brewing, the water used in making beer.

Liquor Well.—In ammonia recovery plants, the receptacle for holding the ammoniacal liquor when separated by heat from the gas.

List.—1. A roll or catalogue; a record of names; as, a *list* of names.

2. A little square moulding; a fillet. called also listel.

3. In carpentry, to cut away a narrow strip; as, of sap wood from the edge of; as, to list a board.

4. A ship is said to list when she lies over to either side.

Litharge.—Lead oxide prepared by roasting the metal lead in air, oxidizing it. As it fuses and solidifies it forms bright reddish yellow scales. It is largely used in the manufacture of flint glass and as a glaze for earthenware. Also in making drying oils, as it accelerates the absorption of oxygen upon which the drying process depends.

Lithium.—A silvery white metal, melting at 370° Fahr. It is the lightest solid known, its specific gravity being 0.59 or 36.7 pounds to a cubic foot. It resembles sodium and potassium, and is a widely distributed element, occurring in sea water, mineral springs, tobacco ash, etc.

Lithograph.—A print made by the process of putting designs or writing with a greasy material on stone, and of producing printed impressions therefrom. The process depends in the main upon the antipathy between grease and water, which prevents a printing ink containing oil from adhering to wetted parts of the stone not covered by the design.

Lithological Lathe.—A high speed lathe used for polishing gem stones or specimens of rock.

Litmus.—A dye which turns blue with alkalis and red with acids.

Litmus Paper.—A paper prepared and sold by druggists, used for indicating certain impurities found in boiler feed water. Water turning blue litmus paper red, before boiling, contains an acid, and if the blue color can be restored by heating, the water contains carbonic acid.

Litter.—Things lying scattered about indicating disorder or untidiness; scattered rubbish.

Littoral.—Of or pertaining to a shore, as of the sea.

Live.—A term expressing anything that is operating or effective; that which exerts force or does work as distinguished from that which is dead or idle. A live axle of a motor car revolves, driving the wheels; a dead axle remains stationary, the wheels revolving upon it.

Live Center.—That center of a lathe which is fixed in the mandrel or live spindle; the center which rotates the work.

Live Head.—A shop term, applied to the *headstock* of a lathe in opposition to the *poppet* or *dead head*.

Live Load.—One that is put on suddenly, or is accompanied with vibrations; as, the force exerted by the connecting rod of an engine, or by a train crossing a railway bridge.

Live Roller.—In machinery, a roller which does not revolve on a spindle, but is free to move around or along its path. Live rollers are used for turntable centers, and the slewing motions of large cranes.

Live Spindle.—The revolving arbor of a machine tool; the spindle of the headstock.

Live Steam.—Steam issuing under pressure from a boiler, as distinguished from *exhaust steam*.

Lixiviation.—The process of separating a saline substance from earthy or other foreign matter by washing, and subsequent concentration of the resultant liquor.

Lloyds.—A society, or establishment of underwriters and others in London, for the collection and diffusion of marine intelligence, the insurance, classification, and certifying of vessels, and the transaction of business of various kinds connected with shipping.

Lloyd's Register.—The principal society for the classification of shipping, which fixes the scantlings and load line of vessels. First met at Lloyd's Coffee House near Royal Exchange, London.

Lloyd's Survey.—The inspection conducted by representatives of Lloyd's Register with regard to hull, machinery and furnishings of vessels, during construction, and at stated subsequent intervals.

Load.—A burden; a weight; as, a heavy load; the work done by a steam engine or other prime mover when working.

Loading.—In navigation and transportation, the act of putting a load on or into; cargo; burden.

Loading Gauge.—A measure, the contours of which denote the maximum dimensions of anything that can pass along a railway.

Load Line.—The line marking the depth to which a ship can be immersed, depending upon her structure, the season, and locality in which she trades.

Load Rating.—In steam engineering, the process of estimating or ascertaining the amount of work done by an engine working up to its capacity. Not to be confounded with the calculation of *duty*.

Loam.—In founding, a mixture of clay with rock sand, incorporated in a mill with charcoal, cowhair, etc., to give it cohesive power and porosity.

Loam Work.—In a foundry, loam moulding or loam moulds, this includes the act of making moulds of loam or its work thereby produced.

Lob.—Something thick and heavy.

Lobby.—1. In smelting and refining, the place where the blocks of ore are broken into pieces with the hammer, for assortment as to quality and for more effectual treatment in the preparatory roasting or calcining processes.

2. In ships, an apartment or passageway in the fore part of a cabin, under the quarter deck.

Lobe.—The larger or most prominent and projecting part of a camwheel.

Lobed Wheels.—Gear wheels whose outline is formed of irregular curves, the projection or lobe on one wheel meshing with a corresponding indentation on the mating wheel. Their use is to furnish a varying rate of rotary motion, similar to that obtained by the employment of elliptical gearing.

Lobsided.—Heavy or hanging down on one side, also spelled *lapsided* and *lopsided*.

Local.—In railroading, a train for the accommodation of a certain district, called also an *accommodation train*.

Locate.—To place; to set in a particular spot or position; to designate the site or place of; as, to locate a steam plant; to select or determine the bounds or place of; as, to locate a shipyard.

Location.—1. In surveying, staking out the boundaries of an area, determining

points through which a road or railway shall pass, or marking out with stakes, calculated sites decided upon for mining or boring operations.

2. Position, site.

3. Anything marked out; a measured area.

Lock.—1. Anything that fastens; specifically, a fastening; as, for a door, a lid, a trunk, and the like, in which a movable bolt is projected by the action of a separate piece, called a key, but cannot be withdrawn so as to release the door, etc., except by another application of the key.

2. An enclosure in a canal with gates at each end, used in raising or lowering boats as they pass from one level to another; called also lift lock.

3. A spring device for exploding the charge of a rifle or other firearm.

Locker.—A closed place; as, a drawer or an apartment in a ship, that may be closed with a lock.

Lock Faucet.—A tap or faucet capable of being secured with lock and key.

Lock Gate.—A water tight door fitted with sluices and working upon hinges, used to close the entrance to a lock on a canal or dock. The water level is equalized either side of the gate to be opened, by means of the sluices, the gate then being swung on its hinges to permit the passage of craft.

Lock Nut.—In mechanics, a nut placed in contact with the main nut on the same bolt to keep the main nut from turning.

Locksmith.—One whose occupation is to make or mend locks.

Locksmithing.—The art or trade of making and repairing locks for doors, etc., and of making and fitting keys.

Locomotion.—The act of moving from place to place; the power of moving from one place to another.

Locomotive.—A self propelling steam engine traveling on wheels, especially one designed for a railway; as, road engine, traction engine, etc.

Locomotive Car.—A locomotive and a car combined in one vehicle; a dummy engine.

Locomotive Engineer.—In railway service, one who drives or manages a locomotive.

Locomotive Scoop.—The regular scoop shovel, commonly called a coal shovel, but known to railroad men and others as a locomotive, or charging scoop.

Lode.—In mining, a vein; a well defined body of metal bearing ore, confined between walls, and generally vertical or inclined, as opposed to a bed or deposit.

Lodestone.—A magnetic iron ore: known as a natural magnet from early times, and the first substance in which the phenomena of magnetism was observed. It is widely distributed and has the power of communicating its magnetic properties to iron and steel, which then become *permanent magnets*.

Lodge.—1. In steam engineering, a reservoir containing a supply of condensing water, to which the discharge from the condenser is returned, waste from evaporation being made up from wells, rainfall, etc.

2. In *mining*, (1) an enlargement in a shaft at the intersection of a level to permit of the handling or loading of skips and kibbles; (2) the *sump*, or reservoir at the foot of a shaft, collecting drainage water to supply the pumps; (3) a room or flat into which the rollers or trammers empty their loads.

3. A workshop.

Loft.—Any upper floor in a warehouse or the like; a floored space or low story directly under a roof; a loft building is a large edifice, principally divided into lofts for various uses, especially storage.

Log.—1. An abbreviation of *logarithm*.

2. A stick of timber butted on the ends; a piece of timber, trimmed of branches, etc., ready for the saw mill.

3. The engine room log kept by the chief engineer, giving a tabulated summary of the performances of the machinery, and the consumption of fuel, together with all repairs executed, etc.

4. A device for ascertaining the speed of a ship. A triangular piece of wood, with one curved edge, known as the *log ship*, is loaded so that it will float upright, and is attached to a length of fine line. This line is divided by knots into equal lengths, each of which is the same fraction of a nautical mile that the time during which the line is allowed to run out is of an hour.

Logarithm.—In higher mathematics, one of a class of artificial numbers, devised by Napier (A. D. 1600), to abridge arithmetical calculations, and by the use of carefully prepared "Tables of Logarithms", to shorten the difficult operations of *raising to powers* and the *extraction of roots*.

Logarithmic Spiral.—In mathematics, a spiral curve such that radii drawn

from its pole or *eye* as equal angles with each other are in continual proportion.

Log Book.—A journal officially kept on shipboard.

Log Chip.—In navigation, the triangular board on the end of a log line, used to indicate the speed of a vessel.

Loggerhead.—1. A runnel on the gunwale of a *whale boat* over which the line passes as it is drawn by the fish.

2. In roofing, a spherical mass of iron, with a long handle, used to heat tar.

Loggia.—A roofed open gallery. It differs from a *veranda* in forming a part of the main edifice to which it is attached; from a *porch*, in being intended, not for entrance, but for an out of door sitting room.

Logging Locomotive.—A special type for use on rough logging lines, having vertical or inclined cylinders working on a crank shaft, running longitudinally.

Logging Track.—A roughly laid railroad, temporarily put down to convey felled trees from the forest to the saw mill, or to water transportation.

Logging Truck.—A strong four wheeled car to carry felled timber on roughly constructed logging railroads.

Log Glass.—In navigation, the sand glass used at heaving the log.

Log House.—A house made of logs notched and joined at the ends.

Log Line.—In navigation, a line or cord about 150 fathoms long, fastened to the log chip and wound around the log reel. Knots made at the proper distances indicate the speed of the vessel in nautical miles per hour. The log line is divided into lengths of 47.33 ft. when used with a 28 second *log glass*, and into 50.75 ft. when used with a 30 second glass.

Log Measure.—An instrument for measuring the number of square feet of inch boards that may be cut from a log.

Log Railway.—A track made of logs laid lengthwise.

Log Reel.—In navigation, a frame with radial arms, or a kind of spool turning on an axis, on which the log line is wound.

Log Rule or Measurer.—In saw milling, a device for gauging logs, taking the round measure, with the allowance for the squaring, and giving the results in board measure of the ascertained square in running feet of the log.

Long Columns.—In mechanics, when the length of a column exceeds its diameter by from 25 to 30 times it comes under the category of long columns, which yield under pressure *by bending alone*, in the same manner that a beam supported at both ends will yield.

Long Division.—In arithmetic, the process of division when the operations are written in full.

Long D Valve.—In steam engineering, a long slide valve used in engines, so called because it extends over the ports at each end of the cylinder, the ports being situated near the ends of the cylinder to avoid the waste of steam consequent upon a long passage.

Longimetry.—The art or science of measuring lengths, whether in straight or curved lines. Mensuration of one dimension.

Longitude.—In geography and navigation, the arc or distance east or west on the earth's surface intercepted between the meridian of a given place and the meridian of some other place from which longitude is reckoned, usually from Greenwich, England, but also, sometimes, from the capital of a country, as from Washington or Paris. The longitude of a place is expressed either in degrees or in time; as, that of New York is 74° or 4 h. 56 m. west of Greenwich.

Longitudinal.—Appertaining to length or to longitude; a longitudinal section is one taken parallel with the length or longest line of the object, as distinguished from a *transverse*, or one taken across.

Longitudinal Elevation.—In architecture, a view showing *the side* of a structure, as distinguished from its *end view*.

Longitudinal Riveting.—The lengthwise seams in a boiler shell, which have to resist the bursting strain of the steam, and are, consequently, sometimes double or treble riveted with inside and outside butt or welt straps.

Longitudinal Seams.—1. In mining, a narrow vein between two thicker strata, running lengthwise of the mine.

2. In boiler making, the line formed by fastening the plates together and running lengthwise of the boiler.

Longitudinal Section.—In drawing, a sectional drawing taken through a structure in the direction of its length.

Longitudinal Stays.—Running from the boiler front to the back plate, and provided with nuts and washers inside and out at each end; the outside washers are much larger so as to hold, more efficiently, the front and back plates together.

Long or Linear Measure.—Is used in measuring distances, and also the lengths of articles.

Longshoreman.—1. An individual who makes his living by casual employment on a wharf or dock; a fisherman who works along the beach or inshore instead of going outside.

2. A laborer employed in loading or discharging cargoes of merchandise.

Long Ton.—Formerly, 112 pounds, or 4 quarters of 28 pounds each, were reckoned a hundred weight, and 2240 pounds a ton, now called the long ton. This is now seldom employed in this country, except at the mines for coal, or at the United States Custom houses for goods imported from Great Britain, in which country such weight continues to be used.

Long Wall.—In coal mining, where the coal is excavated simultaneously along its face, without leaving pillars, the roof falling into the goaf behind the workings, and only the roads being shored or propped up.

Looking Glass.—In glass industry, a mirror made of glass on which has been placed a backing of some reflecting substance; as, quicksilver, tinfoil, black paint, etc.

Lookout.—A seaman or other person keeping watch on the forecastle head or in the crow's nest of a vessel, to look out for lights, approaching vessels, or dangers of the sea.

Loom.—1. A machine in which yarn or thread is woven into a fabric by the crossing of threads, called chain or warp running lengthwise, with others called weft, woof or filling.

2. The cylindrical portion or shaft of an oar, as distinguished from the broad flat portion or blade. Sometimes applied to that portion of an oar inboard of the row locks or thole pins.

Loop.—1. A doubling or crooking of a thread, cord or chain, etc. A short piece doubled on itself and secured at either end.

2. A narrow doorway or small window for admission of light or for the passing in and out of articles; as, in a ticket office of a railway station, or the tool store of a machine shop.

Loop Line.—A line of railway which diverges from the main track, rejoining it at another point, thus forming a loop. Used for branches, for cut offs, or for sidings. Also a similar usage with a telegraph line or circuit, the branch leaving the main line and returning to it further on.

Loose.—Not tight; a term used to denote a part of a machine that is not under tension; as, a loose nut.

Loose Centers.—In machinery, heads very similar to lathe poppets, provided with screw mandrels and center points. They are used as supports for some classes of work, both when being lined out and when being shaped on a planing machine. Hence called machine or planer centers. The center lines and keyways of shafts when suspended between these centers are marked with a scribbing block; lines and distances are also marked off and squared up from a surface plate or marking off table. When clamped or bolted to a planing machine table the work between the centers can be partially or completely rotated to bring different sections under the action of the cutting tool. Both circular and irregular shaping can be done in a planing machine by the use of loose centers.

Loose Eccentric.—A form of reversing gear in which a single eccentric sheave or cam is loose upon the shaft and is driven by projection on the latter. When it is desired to reverse the engine, the gib lever is thrown out, the slide valve moved by hand to start the engines in the desired direction, and, as the opposite lug comes over into contact with the sheave, the gib is once more dropped on to its pin. Much used with oscillating paddle machinery, or small auxiliary machinery on shipboard.

Loose Gland.—In pipe fitting, a form of gland used in making the joints of hot water piping. It is a loose ring furnished with two lugs and bolt holes, and is slipped over the spigot ends of a pipe. An india rubber ring is then placed in front, the spigot is slid into its socket, which has corresponding lugs and bolt holes, and the two are bolted together. The iron ring fitting loosely around the spigot allows of expansion, while the india rubber ring makes the joint water tight.

Loosening Bar.—In moulding, the bar used in the act of rapping or loosening the pattern from its mould, by striking on its side.

Loose Pulley.—A pulley running idly between collars, etc., on a shaft. It is placed beside a fast or keyed pulley to receive the belt when it is thrown off the latter to stop the machine or shaft.

Lopsided.—A term denoting when a vessel or body will not float or sit upright.

Lorry.—1. In mining, a small cart or wagon to carry coal or ore.

2. In railroad engineering, a small wagon or truck for shifting baggage at a station; a large wheelbarrow to remove rubbish from station grounds.

Losing Water.—A term employed when a pump ceases working, either through air entering the suction pipe, or foreign matter choking the rose or strainer at the foot of the pipe.

Loss.—Deprivation of anything; injury or failure.

Loss of Head.—In hydraulics, the diminution in the weight and pressure of a liquid column. Loss of head is due to the friction of long pipes and to the presence of short bends.

Lost Motion.—1. In mechanics, motion in part of a machine producing no useful result, either because of wear in the bearings or through imperfect mechanical construction.

2. The return movement of part of a machine.

Low.—Occupying an inferior position; not high or elevated; depressed below any given surface or place; as, low ground.

Lower.—1. Occupying an inferior position, possessing qualities or characteristics of inferior degree to something else.

2. To let down from one level to another; to let sink or depress.

Low Flashing Point.—In lubrication, an oil is said to have a low flashing point when it will take fire at a low temperature.

Low Freezing Point.—In lubrication, a low freezing point is a valuable property in a lubricating oil in cold countries, since bearings are less liable to become gummed than when the oil freezes readily.

Lowmoor Iron.—A celebrated Yorkshire iron; the Yorkshire wrought irons are nearly pure, on account of the care taken in their manufacture, the iron being *refined* as well as *puddled*. An additional circumstance contributing to their high quality is the entire absence of sulphur from the fuel used in the operations. Lowmoor iron is specified wherever a piece has to stand much working in the fire, or wherever absolute soundness is necessary.

Low Pressure.—In steam engineering, a term used to signify a boiler pressure of not more than fifty pounds to the square inch or thereabouts.

Low Pressure Cylinder.—The largest cylinder in a compound or triple expansion engine; the measure of power in an engine, to which all the pressures are referred for purposes of comparison.

Low Pressure Engine.—One which condenses its steam and discharges it as water in distinction from a *high pressure engine* or one run non condensing.

Low Pressure Heating System.—A mode of heating by steam where the fluid is used at or near the atmospheric pressure. The return to the boiler is frequently effected by means of a pump.

Low Pressure Steam.—Steam having a pressure near to or lower than one atmosphere.

Low Red Heat.—In forging and blacksmithing, a color corresponding with a degree of temperature midway between a *black red heat* and a *bright red heat*.

Low Swing Work.—In machinery, a term applied to a special method of lathe work, which enables the operator to accomplish more work by employing two or more cutting tools, all engaged at once.

Low Water.—In engineering, the lowest stage of water in a steam boiler permissible with safety; below the lower gauge.

Low Water Alarm.—A device operated by an internal float, often fitted to stationary boilers, in which a whistle is blown or the safety valve eased when the water falls below a predetermined level.

Lozenge.—A geometrical figure with four equal sides, two acute and two obtuse angles.

Lozenge File.—A tapered file used by die sinkers, which has a cross section of rhomboid, diamond or lozenge shape.

Lozenge Shaped.—In geometry, a figure formed with four equal sides, having two acute and two obtuse angles; *rhomb-like*

L. P.—An abbreviation for *low pressure*; more especially referring to the low pressure cylinder of a steam engine.

L Rest.—In machinery, a lathe rest for hand turning, made in the shape of the letter **L**, the head on which the tool rests being flat and short, and the leg which fits in the socket being of the usual length. This rest is useful for short work, where the ordinary **T** rest would be too long, and also for attaching to a *slide rest* for temporary hand turning.

L. T.—Abbreviation for *long ton*.

Lubber's Hole.—In navigation, a hole in the floor of the *top* next the mast, through which sailors may go aloft without going over the rim by the futtock shrouds. It is considered by seamen as only fit to be used by heavy, clumsy or awkward fellows.

Lubber's Line or Point.—In navigation, a line or point in the compass case, indicating the head of the ship, and consequently the course which the ship is steering.

Lubricant.—An oil or unguent used to diminish friction in the working parts of machinery.

Lubricating Oil.—1. Any oil used for the purpose of diminishing friction.

2. Engine oil for lubricating external running parts, as distinguished from that used for internal lubrication.

3. A mineral lubricant obtained during the distillation of petroleum.

Lubricating Pad.—A woven cushion of horsehair, worsted or similar material, mounted on springs in the lower half of an axle box, which, by contact and capillary attraction, keeps a film of oil on the journal.

Lubrication.—1. In machinery, to cause to slip easily; to supply to moving parts and their bearings, grease, oil or other lubricant, for the purpose of lessening friction.

2. The theory of lubrication, is the interposition of a film of unguent between the two surfaces which are supposed to rub together by reason of the motion of one of them. The friction of the surfaces on the unguent is less

than their friction on one another, so that lubrication lessens friction, saves power and diminishes the risk of damage, wear and tear. For steam cylinders, air compressors, etc., a lubricant with a high flash point or temperature of decomposition, and great viscosity is needed, qualities found in mineral oils only; heavy bearings require an oil with great weight and body, so that it shall not be squeezed out by the pressure; small high speed parts require a thinner oil. These latter qualities are provided for by different compounds of animal and vegetable oils, with some mineral additions.

Lubricator.—A device for containing oil or grease and supplying it in regular amounts to a journal or bearing. The supply is fed either by worsted syphons, by gauged drips, or by a needle which comes up from the shaft through the neck of the lubricator and induces feeding by capillary attraction and the shaking of the needle. Also called *sight feed lubricator*, *grease cup*, etc.

Luff.—A marine term, meaning to bring a ship closer up into the wind.

Luff Tackle.—In rigging, a purchase composed of a double and single block and fall, used for various purposes; as, on ships, etc.

Lug.—That which projects like an ear; as, the handle of a pitcher; a projecting piece in machinery; to communicate motion, etc., especially a short flange by or to which something is fastened; also, a projecting piece upon a founder's flask or mould.

Luggage.—A traveler's effects; baggage.

Lugger.—A small vessel fitted with lugs, which are sails without lower yards or booms, and bent to yards nearly at right angles to the mast.

Lug Sail.—A sail, nearly rectangular in outline, carried by a yard, which is slung two thirds of its length from the peak.

Lukewarm.—Moderately warm; neither cold nor hot; tepid.

Lull.—To become gradually calm; to subside; to cease or abate for a time; as, the wind lulls.

Lum.—In mining, a ventilating chimney over the shaft of a mine; a chimney.

Lumber.—Timber hewed or sawed into convenient shapes for use. The term conveys the idea of wood dressed into large beams or joists near where it was felled.

Lumbering.—The operation or business of felling trees, roughly dressing or squaring them, and getting them out for transportation.

Lumber Kiln.—In the lumber trade, a heated chamber for artificially drying lumber. For several purposes, as for making patterns, musical instruments, surveying instruments, etc., it is required to use seasoned timber. Two to five years are required to season lumber, according to its size and nature. It can be effected more rapidly if it be steamed, but it should be noted, excess 'n steaming kills the elasticity of the timber, and too rapid kiln drying evaporates the surface moisture and causes the timber to *check*.

Lumber Yard.—A place where dressed lumber, or timber, is stacked for storage or seasoning; the place where a lumber dealer carries on his business and holds his stocks.

Luminiferous.—Light bearing; said of any substance which emits light or transmits it.

Luminosity.—The state of being luminous or of emitting light.

Luminous Flame.—That which burns with a bright yellow to white color. All flame under a boiler is not luminous, sometimes the whole or a part of it will be red or blue.

Luminous Paint.—A pigment which emits light in a dark place. Olive oil has the property of dissolving a little phosphorus, if that substance be immersed in a bottle of oil and kept there for a few days. If the oil be then painted on any object, the latter is visible in a dark room and will so continue until the phosphorus is oxidized. Commercial luminous paints are made from calcium and borium sulphides, etc., which are ground with oil.

Lunar.—1. Of or pertaining to the moon in navigation; as, lunar observation.

2. Measured by the revolutions of the moon; as, a lunar month.

Lunar Caustic.—Fused nitrate of silver; so named because silver was called *luna* by the old chemists.

Lunar Observation.—An observation taken of the moon's distance from a star, to determine the longitude

Lunar Year.—The period of thirteen lunar months, one month being added at intervals to make the mean length that of the solar year.

Luster.—Glitter; brightness of things which do not shine with their own light; as, metallic luster, resinous luster. Also spelled *lustre*.

Lute.—To seal up crevices with lute; to make fast with some hardening mixture or fluid. In piping, luting is a mode of connecting pipes, or tubes, or vessels, to prevent the entrance or escape of gases. In brass foundries, crucibles are often luted by placing an empty one over the one containing the metal, or by placing a cover on it.

Lutes.—These are soft adhesive mixtures, principally earthy, used for closing apertures existing at the junction of different pieces of apparatus used for melting; the material used for rendering air tight those vessels which have to be exposed to the heat of a melting furnace; as, *crucibles, annealing pots, etc.*

Lye.—An alkaline solution; usually water impregnated with carbonate of potassium from the leaching of wood ashes. Used in the manufacture of soap, in neutralizing acids, as a detergent of grease spots, etc.

Lye Tank.—A reservoir holding an alkaline solution in which are immersed portions of machinery under repair to cleanse them from accumulated grease and dirt.



M.—1. The thirteenth letter of the English alphabet.

2. As a numeral M stands for one thousand, both in English and in the Roman table of notation.

Macadamized.—A carriage road laid out according to plans perfected by John Loudon Macadam, a Scottish engineer. It consists in first removing the top soil to the depth of about fourteen inches. Coarse cracked stone is then filled in to the depth of seven inches, and this is covered with seven inches more of smaller stones, and steam rollers are then used to crush it all into a compact mass, making a smooth and level roadway.

Maceration.—The process of softening a substance by soaking it in a fluid, usually without heat.

Macerator.—An apparatus for converting paper or fibrous matter into pulp.

Machete.—A Spanish implement for cutting cane, corn, vines, etc. It is made in large quantities for the Southern market, where it is used to great deal by the natives for cleaning underbrush, etc. Surveying crews in Central and South America have always a number of men with machetes. It is astonishing to see the natives handling this implement; it can be used to cut a piece of bread, to split a corn husk, or to cut weeds, underbrush or young trees. It makes also a very dangerous weapon.

Machicolated.—In the architecture of the Middle Ages, when a disordered condition of society made it necessary that a man's house should be his castle, it was often the case that a building would have a projecting vault or gallery built out from the walls above the first story which would be supported by projecting beams or *corbels*. Then in case of attack, molten lead, hot pitch, or missiles could be dropped through openings in the floor or walls on the enemy beneath. A building thus constructed was said to be *machicolated*. The same idea may be seen in the blockhouses which the early settlers built to protect themselves from the Indians.

Machine.—This word is most commonly applied to such pieces of mechanism as are used in the industrial arts, for mechanically shaping, dressing, and combining materials for various purposes; machines are frequently named from their use; as, screw cutting machines, or from the thing made or acted upon; as, machine ruler; *compound machines* are formed from two or more *simple machines*. Tools are the simplest implements of

art; these when they become complicated in their structure become machines, and machines when they act with great power, take the name, generally speaking, of *engines*.

Machine Bolt.—A bolt screwed at one end, with a head on the other, used

to secure two pieces together, passing through clearance holes in both, and fastened with a nut on the far side. The head of a machine bolt is generally square or hexagon, although round, snap, countersunk, or other heads are used for special purposes.

Machine Drilling.—In machinery, the drilling of work under a power driven machine. All repetition work and much of the heaviest work is done under a machine.

Machine Foundations.—Machines doing heavy work, drills, planing, slotting, shaping, punching, shearing and other machines of this class are bolted to massive *foundations* of stone or concrete, tail bolts being sunk into the foundations to which the machine bases are bolted.

Machine Moulded.—In foundry practice, the process of moulding. Simple forms, required in great numbers, made by machines, many of which are semi-automatic. Toothed wheels are conveniently made in this manner, as three or four teeth at the end of a turning radial arm are made to shape every cog in succession without need of a complete and expensive pattern.

Machinery.—This is a term which easily comes from the word machine, and denotes the parts of the latter *taken as a whole*; its secondary meaning is where a number of machines and tools are to be considered as a group; *i. e.*, the machinery in a watch factory, the machinery in a shop, etc. The machinist gets his designation also from the word machine; in the rating of the U. S. Navy an engine room artificer is called "a machinist" of different grades. Most machines are combinations of some or all of the mechanical powers. Thus the lever is combined with the screw in a common press; the wheel and axle with pulleys, in various ways, and with the endless screw; pulleys are combined with pulleys, and wheels with wheels. The wedge is the only one among the mechanical powers that does not admit of combination with others. In gear wheels the number of teeth in each ought

to be prime to each other, that the same teeth may not meet at every revolution, but as seldom as possible.

Machinery Steel.—Steel suitable for making parts of machinery, but not for cutting tools.

Machine Screw.—A fine threaded screw used to connect parts of machinery together, having a bolt thread such as the V or U. S. standard, as distinguished from a *wood screw*. The machine screw usually passes through a clearance hole in one piece to secure it to another which has a threaded hole.

Machine Shop.—1. The department of an engineering works where parts are machined to proper sizes, superfluous material being removed by lathes, planers and milling machines, etc.

2. The repair shop of a factory. For its most effective use, the shop may be considered a machine, sometimes large and sometimes small, of which the equipment and men are the moving parts. These are so placed as to work one with another, so that the product, passing through the shop, reaches the finished condition with the least expense, in the desired state of finish and accuracy, thus effecting the combination of superiority and low price.

Machine Tap.—A tap as used in machines, having a long shank usually of smaller diameter than the bottom of the thread, so that nuts, etc., may follow on the shank, enabling several to be tapped in succession without stopping or reversing.

Machine Tool.—A machine for cutting or shaping woods, metals, etc., by means of a tool; especially, a machine, as a lathe, planer, drilling machine, etc., designed for more or less general use in a machine shop, in distinction from a machine for producing a special article, as in manufacture.

Machining.—To subject to the action of machinery.

Machinist.—A constructor of machines and engines; one versed in the principles of machines, one skilled in the use of machines.

Madder.—A vegetable extract sometimes used in forming paints, which receive their names from their colors; as, *madder brown*, *madder carmine*, etc.

Made Land.—Marsh land or land made in marshy places by filling in.

Madrier.—In mining, a plank used for supporting the earth.

Magazine.—A receptacle in which anything is stored or deposited.

Magazine Rifle.—A firearm fitted with a magazine into which a number of cartridges are loaded at one time by means of a clip. The lock mechanism provides for the ejection of the empty shell and the loading of a fresh cartridge by one movement, so that several rounds may be fired without removing the piece from the shoulder.

Magdeburg Hemispheres.—An apparatus for demonstrating the pressure of the atmosphere, devised by Otto von Guericke of Magdeburg, during the sixteenth century. Two hollow brass cups or hemispheres were furnished with an external handle, a vent and a cock to close it. On placing the two halves together, and exhausting the confined air, the atmospheric pressure holds the hemispheres together. Von Guericke made very large hemispheres and hitched several teams of horses to either one, failing to pull them apart at the joint.

Magic Square.—Numbers so disposed in parallel and equal rows in the form of a

2	7	6
9	5	1
4	3	8

square that each row taken vertically, horizontally, or diagonally shall give the same sum, the same product, or a harmonical series, as the numbers taken are in arithmetical, geometrical or harmonical procession.

Magistrate.—A person clothed with power as a public civil officer.

Magma.—1. A crude or kneaded pastry mass.

2. The thick residue obtained after subjecting certain substances, such as vegetable oil seeds, to pressure, in order to extract their liquid parts.

3. The grounds or sediment remaining after treating a substance with water, alcohol or other solvent.

4. The ground mass or basis of a rock. The molten mass from which the primary rocks have subsequently solidified.

Magma Pump.—The term *magma* includes any crude mixture, especially of organic matters in the form of a thin paste, it also means "a confection," hence, the name given to a pump belonging to a sugar house apparatus, designed for moving the various thick, heavy mixtures and semi-liquids, occurring in the process of sugar making.

Magnesia.—A fine, light, white powder, having neither taste nor smell, almost insoluble in boiling, but less so in cold water. Magnesia as found in feed water exists in two states, oxide and carbonate. Magnesia,

in combination with silica, enters largely into the composition of many rocks and minerals, such as soapstone, asbestos, etc.

Magnesite Brick.—In furnaces, fire bricks used as linings in converters and rotary puddling furnaces. They are formed of impure magnesia calcined and mixed with from 15 to 30 per cent. of raw and partially calcined magnesia, and from 10 to 15 per cent. of water, the whole being dried and burnt.

Magnesium.—In chemistry, a light silver white metallic element, malleable and ductile, quite permanent in dry air but tarnishing in moist air. It burns, forming the oxide magnesia, with the production of a blinding light, the so called magnesium light, which is used in signaling, or in photography where a strong actinic illuminant is required.

Magnet.—A species of iron ore which has the property of attracting iron and some of its ores, and when freely suspended, of pointing to the poles. Also called *natural magnet*.

Magnetic Clutch.—A clutch in which engagement is effected by passing currents through electro magnets which attract the sliding connections to them.

Magnetic Iron Ore.—A native oxide of iron, possessing the property of attracting iron fragments. When crystallized it is known as *lodestone*.

Magnetic Metal Separator.—1. A machine employed in sorting out iron particles from brass turnings and filings by means of magnetic attraction. The turnings are fed into the machine and pass between rolls armed with magnets, and iron or steel fragments adhering to the latter are swept off into receptacles by brushes, against which the magnets revolve, while the brass falls straight through.

2. A similar device which has been employed to separate iron from finely pulverized ore.

Magnetic Needle.—A slender bar of magnetized steel, usually pointed, and resting on a vertical pivot, in a mariners', surveyors', or other compass, so as to turn freely toward the magnetic poles of the earth.

Magnetic Pole.—One of the points on the earth at which the dipping needle is vertical, or the magnetic intensity greatest.

Magnetism.—In physics, the adherence of particles of metal to the points of drills, and metal turning and other tools, due

to the development of the *residual* magnetism therein by friction.

Magnetizing.—The process of passing the *slip*, in earthenware manufacture, through a machine, furnished with revolving magnets, which remove any particles of iron in the material.

Magnifying Glass.—A lens which magnifies the dimensions of objects when seen through it.

Magnitude.—Something of measurable extent; as, a line, surface, or solid; size.

Mahlstick.—A stick used by painters as a rest for the hand while working.

Mahogany.—A tree found in Central America and the West Indies whose wood is highly valued; it is of a rich reddish or yellowish brown color, sometimes of figured grain, and hard enough to take a beautiful polish.

Mail Chute.—A labor saving device; conduits or rectangular pipes leading from the upper floors of a building to the lower, wherein letters may be dropped for collection at the street level, to save the tenants going downstairs to post them.

Main.—A principal pipe; as, in a gas or waterworks system, through which a locality is supplied, *branches* leading off to various side streets, from which again *supply pipes* lead to individual buildings.

Main Bearings.—In mechanical engineering, the bearings of the crank shaft of an engine.

Main Deck.—The principal deck or floor in a ship, its situation depending on the type of vessel.

Mainmast.—The principal mast in a ship or other vessel.

Main Rod.—In a locomotive, the connecting rod.

Mainspring.—1. The driving spring of a watch, so called to distinguish it from the *balance* or pendulum spring, which gives the recoil movement to the balance.

2. In a typewriting machine, a spring which moves the *carriage* along to the left as each letter is struck.

Maintenance.—The act or process of keeping a railway mechanism or structure in a state of efficiency and good order. Repairs, cleaning, and inspection are a part of maintenance.

Mainway.—In mining, a Cleveland iron miners' term for the principal subterranean passage in a mine.

Majolica.—A variety of earthenware coated with an opaque white enamel; it is made in Spain and the Island of Majorca, from whence its name was probably derived.

Major.—Greater in number, quantity or extent.

Major Axis.—The axis of a body is a line, real or imaginary, passing through it on which it may be supposed to revolve; the major axis is the longer one, the minor axis the shorter one; as, the line between the two ends of an egg is the major axis while that from one side of the egg to the other is the minor axis.

Make.—To form out of given materials; as, to make a shovel; to put into desired form.

Makeshift.—That with which one makes a shift or change; a temporary expedient.

Making Joints.—In pipe fitting, the bringing together and "making up" the joints of steam and water pipes.

Malacca Tin.—In metals, called also *Banca tin* and *Straits tin*. It is sold in pyramids weighing about one lb. each.

Malachite.—A double carbonate and hydrate of copper, found in many places, especially in Siberia. A very valuable copper ore, but used as an ornamental stone on account of its beautiful green color.

Male.—That one of a pair of corresponding parts which fits into the other; as, a shaft in a bearing or a bolt in a nut, the other piece being termed the *female* element; external threads are known as *male threads*.

Malleable.—Capable of being worked into shape under the hammer, by reason of ductility or tenacity of the material.

Malleable Castings.—Cast iron which is changed into a composition approaching that of wrought iron, by the following process, in which excess carbon is eliminated. The castings are carefully cleansed by pickling, then stacked in trays within an annealing furnace covered over by mill scale or other oxides of iron. Heat is applied, the contents are rapidly brought up to a white heat, and then allowed to cool very gradually, generally

taking a week in so doing. Gear wheels, conveyor parts, and many small details of machinery subject to shock are made by this process.

Mallet.—A wooden hammer or light maul; in mining, the hammer used in striking the boring drill.

Malt Kiln.—A kiln or drying shed where the sprouted grains of barley are exposed to heat, which checks the germination, making malt of them.

Malt Shovel.—A wooden scoop or shovel used to turn over the barley upon the malting floors.

Manage.—To control, regulate or direct the movements of an enterprise, shop, railway or the like.

Management.—Those collectively who manage any business, institution or the like.

Manager.—One who manages; a director. In machinery, the name suggests two things: a shop and a manager; or, to enlarge a little, shops with machinery in operation and a foreman; again, to widen the view still further, shop management may properly include as its field of operations, a vast establishment with thousands of skilled and unskilled workmen, with their gang bosses, foremen, and superintendents of departments, the whole animated and directed as a single whole by a *general manager*, who in turn is responsible to a board of directors, representing the capital employed.

Mandrel.—1. The driving spindle of a lathe, rotating in coned bearings in the fast headstock, carrying the driving center or the chuck which carries the work.
2. A round bar with properly centered ends, and a slight taper on its length, upon which rings and similar objects are mounted after boring, so that their exterior surfaces may be true with the hole.

Mandrel Head.—The driving or fast headstock of a lathe, containing the mandrel, cone pulley and back gearing.

Mandrel Socket.—A well tool for straightening out the top of casing, etc., within a well, consisting of a lemon shaped swage within a cone or bellmouth, by means of which the casing is worked to a circular shape. Also useful for straightening a lost sand pump, etc., so that the dogs may enter.

Man Engine.—A contrivance for raising or lowering miners in a shaft, wherein a vertical (or inclined) rod of wood or iron, provided with stages at proper intervals and handles at convenient heights above them, reciprocates, actuated by a crank or steam

cylinder, between platforms placed at distances equal to the stroke of the engine. A miner wishing to descend, awaits the completion of the upstroke, steps on the rod stage, and is carried to the next lower collar, where he steps off to await the next down stroke. To ascend, he steps on at the completion of the down stroke, and so by stepping from stage to platform and vice versa, he is carried up or down the shaft as required.

Manganese.—A metal resembling and possessing a remarkable affinity for iron. It is generally found in the form of oxides, and is widely used as a chemical reagent and oxidizer. Conjointly with hydrochloric acid, it evolves chlorine gas; combined with chlorate of potash and caustic potash, it forms permanganate of potassium, a well known disinfectant; is added to steel to neutralize phosphorus, and also has the valuable property of rendering that metal non magnetizable.

Manganese Bronze.—An alloy of copper, tin and ferromanganese ore, which resists the corrosive action of sea water, and bends rather than breaks under a blow.

Manganese Steel.—A mixture of steel with the metal manganese, producing an alloy of greater toughness and strength than ordinary steel.

Mangle.—A machine for smoothing textile fabrics in finishing processes, or for similar purposes with regard to household clothes, etc.

Mangle Wheel.—A reciprocating gear wheel having its teeth so arranged that it turns back and forth on its center, without making a full revolution.

Manhole.—1. An opening by which to enter a steam boiler, tank, sewer, aqueduct or the like for cleaning, repairing, or inspecting.

2. A side excavation or refuge in tunnels.

3. In mining, the passage through the horizontal platforms or solars in the shaft, leading from one ladder to another.

Manhole Cover.—In a steam boiler, a plate and frame commonly opening inwards and large enough to admit a man into the interior; these openings are sometimes made on the top and sometimes at the end of the boiler. Manhole openings in steam boilers should invariably be located in the head of the boiler, except in rare cases that may arise, when circumstances require it to be placed in the shell. The manhole, so placed, will not materially reduce the strength of the boiler, and from this position it can more readily be seen that the boiler is kept in proper condition.

Manifold.—1. Multiplied; numerous, many in number.

2. A connection with numerous branches used to convey fluids between a large pipe and several smaller ones.

3. A header for a coil.

Manifold Writing.—A process or method by which several copies, as of a letter, are made at the same time.

Manila Hemp.—A fiber of the same genus as the banana. When dressed it is of two qualities, the finer being made into handsome shawls, the coarser into ropes; as, *manila rope*.

Manipulation.—The act of handling work by hand, use of the hands, in an artistic or skillful manner, in science or art.

Manner.—In mechanics, mode of action; way of performing or effecting anything; method.

Manometer.—An instrument for measuring the elastic pressure of gases; a general term including all varieties of pressure gauges, such as tube, spring, syphon and mercurial types.

Man Power.—In mechanics, roughly one tenth of a horse power; or 3300 foot pounds per minute.

Mantissa.—The decimal part of a logarithm; that portion which is given in the tables, and to which the necessary characteristic must be prefixed by the computer.

Mantle.—1. In mechanics, anything which clothes or envelopes.

2. The outer masonry of a blast furnace.

3. A pipe or closed conduit leading water from a forebay to a water wheel.

4. In foundry, clay is sometimes laid over a wax pattern, and on melting out the wax, the clay mantle is left to serve as a mould.

5. A cap or cover of meshed material rendered incandescent by a flame playing upon it; as, the Weisbach mantle.

Mantrap.—A dangerous place; as, an open hatch, into which one may fall.

Manual.—Of or pertaining to the hand; done or made by the hand; as, *manual labor*.

Manual Power.—The muscular power of men's arms. The mean effect of a man's power, unaided by machine, is the raising of 70 pounds 1 foot in one second, or 4200 minute foot pounds, for 10 hours a day. Two men working at a windlass with the handles at right angles to each other, can raise 70 pounds more easily than one man can 80 pounds.

Manufacture.—To produce a finished article from the raw material. Originally, as the name implies, the term signified *making by hand*, but the sense has been extended to include all production either by hand or machinery, usually on a large scale.

Manufacturer.—A person engaged in the business of working raw materials into wares suitable for use.

Manuscript.—Something written with the hand; writing as opposed to printing.

Manway.—In mining: (1) a manhole; (2) a passage used for ventilation or for transit of the miners, but not for the movement of coal.

Map.—A representation of the surface of the earth, or some portion of it, showing the relative position of the parts represented; usually on a flat surface.

Maple.—A tree common in the temperate zone all over the globe; valued both for its shade and ornamental effect, as well as for its wood. There are over fifty species; bird's eye maple is highly valued for cabinet finish, and the rock or sugar maple yields a sweet sap, from which sugar is made.

Mar.—A mark or blemish made by bruising, scratching, or the like; an injury; a disfigurement.

Marabou.—A raw silk which is so white that it can be dyed without removing the natural gum: so called from its resemblance to the soft down feathers of the *marabou stork*.

Marble.—A compact limestone of a more or less crystalline structure, capable of taking a high polish, used largely for building and decorative purposes.

Margin.—1. In building, the exposed portion of a slate, tile or other roof covering. The width of the margin is known as the *gauge*, the part covered by the next higher is the *cover*, the part which overlaps the next lower is the *lap* or *bond*.

2. An edge or border around anything, particularly the blank space left between the type and the edges of the paper on a printed page.

3. The difference between the cost and the selling price of anything.

4. The amount of latitude upon which to work, constituting the limits between which anything may vary.

Margin of Safety.—A shop term, signifying *factor of safety*.

Margin Trowel.—A square trowel used by plasterers when working in the angles formed by two walls.

Marine.—Of or pertaining to the sea; having to do with the ocean or with navigation.

Marine Boiler.—Any boiler designed for service afloat. The chief requirements are that the furnaces be enclosed within the boiler, and that the latter be self contained, without any brickwork. In some types the course taken by the products of combustion is as follows: The coal enters through the furnace doors on to the fire bars, the heat and flames pass over the fire bridge into the flame or combustion chamber, thence through the tubes into the smoke box, up the up-take and funnel into the air.

Marine Engine.—A steam engine designed to propel vessels through the water. As generally understood by the term, an inverted vertical engine for driving a screw propeller.

Marine Engineer.—1. A designer of marine engines and boilers.

2. An officer who is responsible for the care and operation of the propelling and auxiliary machinery on shipboard. To hold such position it is necessary to have had actual experience in the construction of similar machinery, to have had experience in subordinate positions afloat, and to have obtained by verbal and written examinations, a certificate of competency issued by the national government.

Marine Glue.—A glue composed of india rubber, shellac, and a solvent oil, such as coal tar naphtha; it is applied hot to canvas, wood, etc., where a water tight joint is desired.

Marine Governor.—An automatic apparatus to control the steam admission and thus check racing of the main shaft of a steam vessel, when the propeller is raised, by the waves, above the water.

Marine Surveyor.—A consulting shipwright or naval architect, either in private practice or employed by a government department or registration bureau: (1) to inspect the fabric of a vessel and her equipment, to ascertain that all official requirements have been met or that repairs and maintenance are executed in a proper manner; (2) to certify that cargoes have been properly stowed, or that the ship is in a proper condition to receive certain commodities; (3) to assess damages or losses for purposes of insurance.

Mariotte's Law.—The same as Boyle's law. These relate to the manner in which gases expand and contract, steam being a gas the expansion follows substantially the law of Boyle, or Mariotte, according to which the pressure falls in the inverse ratio of the expansion, the temperature remaining constant.

When steam is admitted to a cylinder during a portion of the stroke, then cut off, and expanded in the cylinder, upon the piston, for the remainder of the stroke, the pressure on the piston during the period of admission, is or ought to be uniform, while the pressure during the period of expansion falls as the piston advances and the steam expands.

The actual changes of pressure seldom follow the law exactly. The pressure usually falls more rapidly in the first portion of the expansion, and less rapidly in the last portion, than is indicated by the law on account of initial condensation and re-evaporation, respectively.

Mark.—1. A distinguishing sign or token.

2. An object of endeavor; a point to be striven for.

3. A German silver coin equal to a little more than twenty cents in U. S. money.

Marker Out.—In machine shop practice, a workman whose special duties consist in marking out the centers, lines, etc., of metal work in readiness for the machinists and fitters.

Marking Gauge.—In tools, a gauge used for marking the thickness of timber which has to be planed to a certain dimension throughout.

Marking Ink.—Indelible ink, used in marking linen, etc.

Marking Machines.—Devices and machines for placing on flat or round metal surfaces, impressions of trademarks, patent dates, graduated scales, and a variety of similar work.

Marking Off Table.—In machine shop practice, a planed cast iron plate or table, strengthened and stiffened with flanges upon the under side, and employed as a basis for marking off the centers and working lines on rough castings and forgings before they go to the machines to be planed, turned, and bored. Being planed true on face and edges and blocked up and leveled, the square and scribing block can be employed with accurate results. The marking out table is a necessary adjunct in all fitting shops of moderate and large size, so that the sole responsibility of lining out rests with the two or three men who are employed thereon.

Marl.—1. In rigging, to cover a part of a rope with a small line, making a peculiar hitch at each turn to prevent unwinding, and protect the rope from being weakened by fretting.

2. A mixed earthy substance, consisting of carbonate of lime, clay, and sand in very variable proportions, and accordingly designated as *clayey* or *sandy*.

Marline.—In rigging, a small line composed of two strands and but little

twisted, used for winding around ropes and cables to prevent their being weakened by *fretting*.

Marline Spike.—A long pointed tapering tool, with an eye at the butt end for slinging by a lanyard, used by riggers and seamen to open the strands of rope for splicing, etc., or to manipulate marline in serving bends, hitches, etc.

Marquetry.—An inlay in furniture, usually of wood, also of shell or ivory, to give a decorative effect. It is usually in scroll work or arabesques.

Marsh.—A tract of soft wet land, commonly covered, partially or wholly, with water; a swamp; a morass.

Marshall Valve Gear.—A single eccentric reversing gear, in which the slide-valves are placed at the side of a vertical engine, the eccentric working them through a horizontal rod and an arrangement of swinging links. By altering the angle of these links, a motion in either direction may be obtained.

Marver.—In glass making, a polished cast iron slab on which the glass blower shapes the fused glass which he has on the end of his blow pipe.

Marvering.—The process of rolling and pressing fused glass on a flat table called a marver.

Mash.—A mass of mixed ingredients reduced to a soft pulpy state by beating or pressure; a mass of anything in a soft pulpy state, as of meal made from rye, corn or other grain, steeped and stirred in hot water.

Mason.—A man whose occupation is to lay bricks and stones in walls or structures of any kind.

Masonry.—The art of so arranging brick, stone, or concrete as to produce a regular construction; anything constructed of the materials used by masons.

Mass.—1. A quantity of matter cohering together so as to make one body; as, a mass of ore, coal, etc.

2. In physics, the *mass* of a body, or the quantity of matter it contains, is a constant quantity, while the *weight* varies according to the variation in the force of gravity at different places.

Massive.—Forming, or consisting of, a large mass; as, massive rock, as granite.

Mast.—A pole of timber or steel tube, which is fixed more or less vertically in a ship, and which supports the rigging, sails, etc.

Master.—One exercising authority; a person having the right to control; a proprietor.

Master Car Builder.—The head of the car department of a railroad, superintending construction, maintenance and repair of rolling stock.

Master Key.—A key which can be adapted to the opening of many different locks.

Master Mechanic.—The chief mechanical engineer of a railroad or one of its divisions.

Masterpiece.—Anything done or made with great skill; a supreme achievement.

Master Tap.—A standard tap used in the manufacture of dies, or kept as a standard of size.

Master Valve.—A controlling or auxiliary shut off valve in a system of piping.

Master Wheel.—In machinery, a dividing wheel used for cutting the teeth of gears. It is properly of large diameter, in order to lessen errors due to its own pitching out. Such errors are reduced in the case of all wheels smaller than itself. If the master wheel is of small diameter, its errors are magnified when cutting wheels of larger diameter.

Master Workman.—A man specially skilled in any art, handicraft or trade, or who is an overseer, foreman or employer.

Mast Hoist.—In rigging, a steam or electric power lifting machine designed to lift. It is usually of small dimensions and fastened on the mast of the derrick where the hoisting is to be done.

Mastic.—1. A gum or resin.

2. A cement used by builders where great expedition is required, consisting of finely ground limestone mixed with sand and litharge, linseed oil being used to incorporate it to a putty.

3. A putty or cement of any nature.

Masting Shears.—In rigging, shear legs erected over the edge of a dock, and used for lifting and lowering the masts of ships into their hulls. The gearing is usually placed at some distance behind the shears and the power is transmitted thereto through chains.

Mast Winch.—In rigging, a hoisting machine either worked by hand or power and secured to a ship's mast; or a pillar in shop use. It may have single, double or treble gearing with brakes and other improvements.

Match Boarding.—In carpentry, boards fitted together with tongue and groove, or prepared to be so fitted.

Matched.—A plank or board having a tongue on one edge and a groove on the other, so that the edges will fit together and form a tight joint.

Matching and Planing Machine.—A woodworking machine, for tonguing and grooving boards.

Match Plane.—In carpentry, a moulding plane used to form either the tongue or the groove on the edge of match boarding, etc.

Match Plate.—In founding, a plate having one half the pattern on one side and the other half on the other, made by ramming the cope and nowel in the ordinary manner, and then separating them at a distance equal to the thickness of the proposed plate.

Mate.—A shop term for any man working with another man, but the term is more particularly applied to smiths and their hammer men, to boiler makers, platers, and angle iron smiths and their *strickers*, because they always keep together and only change in case of illness or dismissal.

Material.—That of which anything is composed or may be constructed; as, the material for making a shovel; raw material, that from which other industrial products may be made; as, lumber is raw material for building a house.

Mathematical Signs.—Marks or characters used as abbreviations in arithmetic, and to a greater extent in algebra and algebraic arithmetic; the principal signs are:

+ Read *plus*; signifying addition; as, $2+3$, meaning that two is to be added to three, or the sum of two and three is to be taken.

— Read *minus*; signifying subtraction; as, $3-2$, meaning that two is to be subtracted from three, or the difference of the two numbers is to be taken.

× Read *into*; signifying multiplication; as, 3×2 , meaning that three is to be multiplied by two, or the product of the number is to be taken.

÷ Read *divided by*; signifying division; as, $3 \div 2$, meaning that three is to be divided by two, or that the quotient of the two numbers is desired. Another method is by using a horizontal line between the two figures, as $\frac{3}{2}$ has exactly the same significance as $3 \div 2$, the fractional method being more usual in formulæ, etc.

= Read *equal to*; signifying equality between the preceding and following expressions; as, $6=3 \times 2$, means that six is equal to the product of three times two.

. Read *point*; signifying that all numbers to the right of it are decimal fractions, the value of each digit diminishing tenfold at each stage of removal, as .32 or point three two equals $\frac{32}{100}$.

Mathematics.—That science which treats of the exact relations existing between quantities or magnitudes. The science of quantities is afterwards divided into pure and mixed mathematics. The branches of pure mathematics are arithmetic, geometry, algebra, analytical geometry, and the differential and integral calculus: the three latter embrace the entire portion of mathematical science in which quantities are represented, not by numbers, but by letters of the alphabet.

Matrass.—In chemistry, a long necked, round bodied glass vessel for distilling and digesting; sometimes small, of hard glass, for blow pipe analysis.

Matrix.—In mineralogy:

1. The rock in which any accidental precious stone, or fossil is imbedded.

2. A mould which gives shape to material forced into it by pressure, or poured in while fluid and allowed to harden; as, plaster of Paris.

Matte.—An impure metal obtained in the smelting of various ores; as, copper or silver. Called also *coarse metal*.

Matter.—Any collection of substance existing by itself in a separate form; matter appears in various forms which however can all be reduced to three classes; namely, *solids, liquids, gases*; a *solid* offers resistance to change of shape always keeping the same size or volume and the same shape; a *liquid* is a body which offers no resistance to a change in shape, and a gas or vapor is any substance in the elastic or air-like shape.

The two essential properties of matter, both of which are inseparable from it, are extension and impenetrability. Extension, in the three dimensions of length, breadth and thickness, belongs to matter under all circumstances; and impenetrability, or the property of excluding all other matter from the space which it occupies, appertains alike to the largest body and the smallest particle.

Matting.—Mats in general, or collectively; mat work; a mat like texture, for use in covering floors, packing articles, and the like. Material for mats.

Mattock.—A pickaxe with both ends broad instead of pointed.

Mattress.—In hydraulic engineering, a mat woven of brush, poles, etc., used in protecting embankments, forming dykes, jetties, etc.

Maudsley, Henry.—Born 1771, died 1831. An English mechanical engineer to whose genius is due the development of machine tools. He early became an expert machinist, constructing many machines from his own designs, and patenting many inventions: he took out patents for printing calico (1805-08); invented block-making machinery (1808), the "table engine" (1807), a method of purifying water on ships (1812), etc.; he devoted much attention to the improvement of the lathe, inventing the slide rest; and in numerous ways contributed to the attainment of perfection in machinery and the best type of workmanship.

Maul.—1. A large double headed hammer.
2. A large heavy wooden beetle or mallet.

Maxim.—An established principle or proposition; an adage; a proverb.

Maxim, Sir Hiram Stevens.—Mechanical engineer and inventor, born at San-gerville, Me., Feb. 6, 1840. He attended the common schools of Maine, and after serving an apprenticeship of four years at the coach-building trade, he was employed in several iron works. When quite a young man he had patented several inventions in the United States. He went to England in 1881, and has since made his home there, being knighted by Queen Victoria, in 1901. He invented the Maxim gun, and many improvements in ordnance; has made numerous inventions for controlling electric currents automatically, and during recent years has devoted much attention to aerial navigation. He is a member of Am. Soc. C. E., chevalier of the Legion d'Honneur of France; member the Royal Soc. of Arts, of England, and various technical organizations.

Maximum.—In arithmetic, the greatest number or quantity attainable in any given case; opposed to *minimum*.

Maximum Pressure.—The utmost pressure which is brought to bear upon the body of a structure. Commonly it has reference to the pressure of elastic fluids and liquids.

Maximum Strength.—In mechanics, this refers to the disposition of a definite quantity of material in such a manner

that a structure of the strongest section shall be designed. Illustrations are to be obtained in the sectional and longitudinal forms of timber beams, iron flanged girders and columns.

Maximum Stress.—The extreme limit of the stresses to which anything under variable load may be subjected. It depends upon the fatigue resisting properties of the material as well as on its elastic limit, and is generally provided for by taking a safe factor as divisor of the ultimate strength; as, in a steam boiler.

Maximum Weight.—In mechanics, the utmost weight or load which a body or structure has to sustain. It has reference to the pressure of dead and variable loads. It is upon the maximum load that the *factor of safety* is based.

McCormick, Cyrus Hall.—Born 1809, died 1884. An American inventor and manufacturer, distinguished for his invention of the reaping machine (1831). He placed the reaper upon the market in 1840, and continued patenting various improvements upon it until 1847, when he erected shops in Chicago for the manufacture of his machines on a large scale. His invention revolutionized the harvesting of grain, and led to the rapid developments of wheat growing the world over.

Mean.—1. Occupying a middle position, or one midway between two extremes.
2. In mathematics, having an intermediate position in a range of values or magnitudes; or forming an average of a number of lesser or greater terms of any kind.

Mean Effective Pressure.—The average useful pressure which tends to do work in an engine cylinder, or the pressure of work done in an air compressor or pump, the back pressure having been deducted from the load on the piston.

Mean Gradient.—The average slope at which a pipe line or water main is laid, or the average gradient of a sewer.

Mean Pressure.—The average pressure exerted upon a piston, throughout its stroke, usually calculated from the average of ten ordinates on the indicator diagram, or by means of the planimeter. The term *mean pressure* is indefinite and should be qualified by the word *forward* or *effective*; as, *mean forward pressure* or *mean effective pressure*.

Means.—The second and third terms of a proportion.

Mean Temperature.—The average temperature observed at a particular place over a number of years; generally noted as annual, or for any particular season or month.

Measure.—That by which anything is measured or ascertained; an instrument or vessel of measurement; as, a foot measure or a pint measure.

Measured Mile.—A course marked off in a waterway, or at sea, where the speed trials of ships are carried out.

Measurement.—The dimension, size, capacity or amount, as determined by measuring; the ascertained result of measuring.

Measurement of Light.—Light can be measured with great accuracy, owing to an invariable law, which is similar to the law of gravitation. *The intensity of light is as the square of its distance*: thus, if two lights of unequal power be made to shine on the surface of a smooth plaster wall, and a book or card be interposed, the two shadows produced by the crossing of the rays will differ in blackness in the same degree as the powers of the two lights; the stronger light will produce the darker shadow. To obtain the difference in power of the two lights, the stronger light must be moved backwards or the lesser light forwards until both shadows are the same tint, which the eye can tell with great exactness.

Measures.—1. Measures are of seven kinds: 1. Length; 2. Surface or area; 3. Solidity or capacity; 4. Weight or force of gravity; 5. Time; 6. Angles; 7. Money or value.

2. In mining, those strata in which the coal of any particular district is found.

Measuring Chain.—A surveyors' or engineers' chain.

Measuring Tape.—In instruments, a narrow tape or ribbon enclosed in a circular casing from which one end is drawn out as required for measurement. Tapes vary from 25 to 100 feet in length and are made of linen strengthened with wire, and also of ribbon steel. Tapes alter in length with the moisture in the atmosphere, but should not be more than $\frac{1}{4}$ inch out of their total length at any time. They are used for outdoor work, for taking circumferences or arc measurements of large pieces of work.

Meat Earth.—A term used in mining to signify vegetable mould.

Mechanic.—A skilled worker with tools and machinery in the fashioning of articles of metal or wood; an artisan or artificer.

Mechanical.—1. Of or pertaining to mechanics; in accordance with the laws of physics.

2. Doing the work of a mechanic; having to do with tools or machines.

Mechanical Arts.—Those in which the hands and body are more concerned than the mind; as in making tools and utensils; these arts are called trades.

Mechanical Drawing.—Drawing which is executed mechanically by the aid of instruments, as distinguished from that executed by the unguided hand.

Mechanical Effect.—In physics, effective power; useful work exerted, as by a machine in a definite time.

Mechanical Engineer.—An engineer whose profession lies with mechanisms and engines, as distinguished from a civil engineer, whose profession is connected with constructions and public works, both being differentiated from a military engineer, whose duties may partake of the functions of both, but for warlike ends.

Mechanical Equivalent.—A heat unit; the mechanical energy equal to the heat necessary to raise 1 lb. of water 1 degree Fahr. Discovered by James Prescott Joule of Manchester, it was given a value of 772 foot pounds, but many further researches have given the value of 778 foot pounds as the mechanical equivalent.

Mechanically.—According to the rules of mechanics; as, work [mechanically good; by mechanical power.

Mechanically Operated Valve.—In an internal combustion engine, or pump, a valve which is moved by gearing or valve mechanism, more especially an inlet valve which is positively actuated instead of automatically opening by suction.

Mechanical Movements.—Any special arrangement or sequence of related parts of a machine acting on each other and accomplishing a motion.

Mechanical Philosophy.—The principles of mechanics applied to the investigation of physical science.

Mechanical Powers.—These are six in number: 1. The lever. 2. The wheel and axle. 3. The pulley. 4. The inclined plane. 5. The screw. 6. The wedge.

Mechanical Puddler.—In melting furnaces, a puddling furnace in which the operations of *hand puddling* are performed automatically.

Mechanical Refrigeration.—The art or process of producing "cold," that is, of creating and maintaining a low temperature, by mechanical means. Generally, a volatile agent, such as ammonia, ether or carbon dioxide is liquefied under pressure, and, on escaping again to a gaseous form abstracts heat from brine, which is circulated through systems of piping to cool storage chambers or vessels containing water to be frozen into ice.

Mechanical Solution.—In mathematics, a solution of a problem by any art or contrivance not strictly geometrical, as by means of the rule and compasses or other instruments.

Mechanical Stoker.—An apparatus constructed to feed and stir the fire automatically, thus relieving the firemen. The principal parts of the machine are: 1, the hopper, which may be filled either by hand shoveling or by elevating and conveying machinery; 2, the conveyor screw, which forces the coal, or indeed, any description of fuel, forward to the, 3, magazine; 4, a driving mechanism, which is a steam motor arranged conveniently in front of the hopper; 5, the retort, so called from its being the place (above the conveyor) where the coal is distilled into gas. In this machine, the fuel is introduced from the bottom of the bed of fuel, technically speaking, upon the principle of "underfeeding."

Mechanical Theory of Heat.—In physics, heat and mechanical force are said to be identical and convertible. Independently of the medium through which heat may be developed into mechanical action the same quantity of heat is resolved into the same quantity of work.

Mechanics.—1. The theory of machines.

2. The science dealing with forces and their action upon matter. This is the modern view of the science, and it is usual to regard mechanics as divided into two branches: *kinematics* and *dynamics*. The former treats of motion alone without reference to the forces which produce those motions, the latter is subdivided into *statics* and *kinetics*, the first dealing with forces acting upon bodies at rest, the second with moving bodies.

Mechanism.—Machinery or a system of machinery; the sum and arrangement of interdependent parts in a machine of any kind.

Medal.—A piece of metal, usually of circular form, struck in a die, to commemorate a person, institution or event; it is called a medal to distinguish it from a coin, which it resembles.

Medium.—1. That which lies in the middle, or between other things; an average.

2. A drawing paper, measuring 22 inches by 17½ inches, used largely in schools.

Medium Hard.—A quality of emery wheel, useful for shaping edges of tools, saws; also for trimming castings.

Medium Soft.—A quality of emery wheel, useful for general surface work, but for grinding narrow edges it wears itself away too rapidly.

Medullary Rays.—In timber, the flat radial fibers which carry the sap from the outside to the inside of a tree.

Meerschaum.—A fine white clay-like mineral, used principally for the manufacture of pipes. Its name, from the German seafoam, has reference to its lightness and snow white color. As it absorbs the oil of the tobacco it changes to a rich brown which is highly valued by the smoker.

Megaphone.—An instrument designed to make the voice audible at a considerable distance, or to aid persons in hearing when they are partially deaf.

Megass.—Sugar cane as it comes out from the rollers, crushed and only fit for fuel. Usually called *bagasse*.

Meikle, Andrew.—Born 1719, died 1811. A Scottish mechanic and inventor. In 1768 he secured a patent for a machine for dressing grain, but his great invention was the drum threshing machine. His first experiments in this direction (1778-84) proved failures, but in 1784, conceiving the plan of employing beaters fixed to a revolving drum, he constructed a machine of a new type, obtained a patent for it in 1788, and the following year established a business for its manufacture. The threshing machine of today, notwithstanding more than a century of development, remains in its essential particulars the same as the machine invented by Meikle.

Melinite.—An explosive of great destructive power; so called from its color which resembles honey.

Melt.—To change from a solid to a liquid by the application of heat. As a noun it is also used to denote the charge of

metals placed in a cupola or pot for melting.

Melting Points of Solids.—The temperature at which solids become liquid or gaseous. All metals are liquid, at temperatures more or less elevated, and they probably all turn into gas or vapor at very high temperatures. Their melting points range from 39 degrees below zero of Fahrenheit's scale, the melting, or rather the freezing point of mercury, up to more than 3,000 degrees:

TABLE.

Melting point of Ice.....	32°
Melting point of Sulphur.....	239°
Melting point of Gold.....	2156°
Melting point of Wrought Iron.....	2732°

Member.—1. Either of the two parts of an algebraic expression connected by the sign of equality.

2. In engineering, any essential part, as a post tie rod, strut, etc., of a framed structure; as, a bridge truss.

3. In architecture, any part of a building; as, a pier, column, lintel or the like.

Memoranda.—Notes to help the memory, or for future reference. The plural of memorandum.

Memory.—The faculty of the mind by which it retains the knowledge of previous thoughts or events; the actual and distinct retention and recognition of past ideas in the mind; remembrance.

Mend.—To repair, as anything that is torn, broken, defaced, decayed, or the like; to restore from partial decay or defacement; to patch up; to put in shape or order again; to re-create.

Mender.—One who mends or repairs.

Mending-up Piece.—In metal working, the strip of wood, plain or curved, as the case may be, which is used for mending. Also, sometimes a strip of lead is bent round a curved edge instead of a sweep cut out in wood.

Menhaden Oil.—Obtained from the menhaden, a type of shad, caught in the waters off the North Atlantic coast of the United States.

Mensuration.—The art of measuring things which occupy space; the art is partly mechanical, and partly mathematical, hence can be illustrated with drawings to aid in the better understanding of the arithmetical problems connected with it.

Menthol.—A white crystalline solid, prepared by freezing from oil of peppermint, of which it constitutes 50 to 60 per cent.. useful in medicine as it produces local anesthesia.

Mention.—To make allusion to ; to direct attention to by a simple reference, speaking of a name, or the like ; to call to the mind of another ; to speak briefly of ; to name.

M. E. P.—Abbreviation expressing the *mean effective pressure* of the steam in the cylinder of an engine. It is the mean forward pressure, less the mean back pressure.

Merchant Bar.—1. The commonest quality of wrought iron bar, produced by piling and re-rolling the puddle or muck bars.

2. Finished bar iron of various sections and sizes, such as are made to standard dimensions for supplying the open market.

Merchant Mill.—The entire plant of rolls and accessories used for the making of tee, angle, and bar iron or steel of various sections.

Mercurial Air Pump.—An exhausting pump which depends for its action upon the formation of a vacuum at the top of a barometer tube by the flow of a column of mercury. The most effective form is the *Sprengel pump*.

Mercurial Steam Gauge.—An instrument for indicating the pressure of the steam in a boiler. It consists of a graduated tube like a thermometer containing mercury, and indicates the steam pressure by the expansion of the mercury caused by the heat of the steam. This type of gauge gives correct saturation pressures, but not the correct pressure of superheated steam. Also called *thermometric steam gauge*.

Mercurial Thermometer.—Consists of a stem or tube of glass, formed with a bulbous expansion at the foot to contain the mercury which expands into the tube. A sufficient quantity of mercury having been introduced, it is boiled to expel air and moisture, and the tube is hermetically sealed. The freezing and the boiling points on the scale are then determined respectively by immersing the thermometer in melting ice, and afterwards in the steam of water boiling under the mean atmospheric pressure, 14.7 pounds per square inch, and finally marking the two heights of the column of mercury in the tube. The interval between these two points is divided into 180 degrees for Fahrenheit's scale, or 100 degrees for the Centigrade scale, and degrees of the same interval are continued above and below the standard points as far as may be necessary.

Mercury.—Quicksilver ; a metal possessing the unique property of being fluid at ordinary temperatures, and having a silvery white color with a bright metallic lustre.

Mergenthaler, Ottmar.—Born 1854. An American inventor of German birth. He devoted the greater part of his life to the perfection of the mechanical type setting machine, beginning as early as 1876 on a machine which in the course of years developed into the linotype, one of the most successful inventions of the age. By the operation of a keyboard similar to that of a typewriter, matrices of type are assembled in line, automatically "justified", and transferred to a mould where an impression is taken from molten type metal, forming a solid line of type. Linotype machines are now in use in all parts of the world with a wonderful degree of success. Mr. Mergenthaler was awarded the Cresson medal by the Franklin Institute of Philadelphia in 1890.

Meridian.—A great circle of the earth supposed to pass through the poles and therefore traversing the earth's circumference in a north and south direction ; all places on the same meridian have noon at the same instant.

Mesh.—1. The opening or clear space between the threads of a net, or between the wires of a sieve or screen ; the space enclosed from one knot to another in the threads of a net.

2. In machinery, the state of engagement between the cogs of two wheels, as between the teeth of a wheel and a rack, or of two spur gears.

Mess.—A disagreeable mixture or confusion of things, hence, a situation resulting from blundering, or from misunderstanding ; as, he made a *mess* of it.

Messenger.—In mechanics, an endless rope or chain used to drive one mechanism from another ; as, a windlass from a steam winch.

Metal.—1. An element that forms a base by combining with oxygen. It is usually a good conductor of heat and electricity ; generally, hard, heavy, malleable and tenacious. Metals, as known to the ancients were ; gold, silver, copper, iron, tin and lead.

2. In glass making, glass in a state of fusion.

3. In civil engineering, the broken stone used in macadamizing roads and ballasting railroads.

Metal Laths.—Lattice or trellis work of metal strips upon which plastering is laid to supersede the wooden laths in customary use ; a preventive against fire.

Metallic Packings.—Owing to the combustible or friable nature of fibrous packings, it is necessary to use rings or segments of bronze or white metal alloy in their stead for packing rods working in high pressure or superheated steam. These rings or segments are generally made in internal and external cones to fit in each other, and are frequently retained in place by means of springs, thus floating them on the rod, to eliminate friction.

Metalliferous.—Containing metals; metal bearing.

Metallography.—The science of examining prepared metallic surfaces under the microscope. After careful polishing and grinding to a smooth surface, the structure is brought out by etching with acid, the surface being preserved for subsequent examination by a coat of transparent varnish. By this method of investigation, the crystalline structure of metals has been demonstrated and the behavior of the molecules under stresses or hardening and annealing is made apparent.

Metalloid.—A term applied to certain elements which present both metallic and non-metallic characteristics, thus partaking of the properties of both metals and non-metals. *Antimony, arsenic and tellurium* are well known examples.

Metallurgical Coke.—Coke made in ovens for blast furnace or cupola use, that recovered from gas manufacture not being sufficiently strong or dense to support the weight of the metal.

Metalurgy.—The science of smelting, or refining metals from their ores by fusion, etc.

Metal Mill.—An iron works where the metal, in the rougher shapes, is made into merchant iron or steel.

Metal Pattern.—In a foundry, patterns are made of metal when too weak to stand usage if made in wood, or when curves have to be imparted thereto, which could not well be given to wood. Hence ornamental works are made in metal, and works where a large number, say several scores or hundreds, have to be cast from the same pattern. Iron, brass, tin, lead, are the metals chiefly used; iron and brass being employed for permanent work, while lead and tin are used chiefly to be bent into various outlines, from which the actual permanent patterns in the harder metals are finally moulded. Patterns in iron are rusted and varnished, or protected with a coating of beeswax.

Metals.—The six metals known to the ancients were gold, silver, copper, tin, iron and lead, and their properties gave shape to the idea of a metal, namely: an undecomposable element possessing

weight, opacity, a peculiar luster, conductivity for heat and electricity, and ductility.

Metal Spinning.—The art or process of forming circular objects out of sheet metals; a wooden chuck or mould corresponding to the desired outline is mounted on a lathe, and a circular sheet of malleable metal, such as Britannia metal, brass or copper is centered against it. As the lathe revolves, the spinning disc is pressed against the wooden mould by means of a blunt nosed tool or a roller, thus conforming it to the desired outline. Bowls, cups, vases, etc., are made in this manner.

Meteoritic Iron.—Masses of nearly pure iron found in various parts of the world, varying in weight from a few pounds to many tons. Containing 1 to 2 per cent. of nickel, having twice as much combined hydrogen as ordinary malleable iron, and being generally oxidized outside with an unoxidized interior, it is shown to be of extra terrestrial origin; that is, it is thrown off by some other planet, or is encountered by the earth on its orbit, having formed part of one of those shoals of wandering bodies known as meteorites, which, flaming through friction with the atmosphere, become "shooting stars." Among many savage races, notably the Esquimaux, meteoric iron is their chief supply of this useful metal.

Meteorology.—The science which treats of the atmosphere and its phenomena; particularly of its variations of heat and cold, its winds, rainfall, etc. Shortly, the science of weather and climate.

Meter.—1. One who or that which measures.

2. An official appointed under a statute to measure quantities of commodities for fiscal appraisement or for purposes of trade; as, a *sworn meter* for grain or corn.

3. An instrument for measuring the flow of a fluid; as, a gas or water *meter*.

Method.—Regular mode or manner of doing anything; orderly arrangement, development, or classification.

Methodize.—To reduce to method; to dispose in due order; to arrange in a convenient manner.

Metre.—A French measure of length, equal to 39.37 inches; the standard of linear measure, intended to be the ten millionth part of the distance from the equator to the north pole, as ascertained by actual measurement of an arc of the meridian. Also spelled *meter*.

Metric System.—The French system of weights and measures of which the unit

is the *metre*, originally supposed to be the one 10,000,000th part of a meridian of the earth. The metric system is purely decimal.

Metrology.—The science of weights and measures.

Metronome.—An instrument, for measuring time, in the study of music. It consists of a clock movement having an inverted pendulum whose period of vibration is regulated by a shifting or sliding weight.

Meyer Cut Off Valve.—An auxiliary slide valve for controlling the admission of steam in an engine, consisting generally of two flat plates working on the back of the main valve, passages being formed through the latter to serve as steam ports. The plates are mounted on a right and left hand threaded spindle; so, by rotating the spindle, the edges are forced further apart, thus increasing the lap and securing an earlier cut off. Turning the spindle in the contrary direction, brings the edges closer together, reducing the lap and lengthening the admission.

Mica.—A mineral capable of being cleaved into elastic plates of extreme thinness. It is either colorless or presents some shade of light brown, gray, smoky brown, black, and occasionally green or violet. It is generally more or less transparent, and is used, like glass, in lanterns, and in the doors of stoves.

Micrometer.—An instrument of precision, for measuring very small lengths, usually by means of rotation of screws of fine pitch, as one twentieth of a revolution of a screw of 50 threads to the inch, gives $\frac{1}{50 \times 20}$, or advances the point $\frac{1}{1000}$ inch.

Micrometer Calipers.—A curved frame of U shape, having at its open extremities a hardened *anvil* on one and a micrometer at the other, rendering it easy to take measurements between them.

Microscope.—An instrument consisting of combinations of lenses and frequently mirrors, whereby minute objects are magnified and rendered visible.

Middle.—Equally distant from the extremes, either of a number of things or of one thing.

Middle Watch.—At sea, the period from midnight till 4 a. m.

Middlings Purifier.—In high milling, a screening or purifying apparatus for separating the *middlings*, or that part of the

kernels of grain which lies next the skin of the berry, from the flour, the overtails or retained portions going once more to be re-ground with coarse wheat particles.

Mid Feather.—A horizontal water bridge back of a boiler furnace having a flame passage above and one below it. In mining, the support to the center of a column. In paper making, the partition between the two halves of a pulp; breaking machine.

Mid Gear.—In steam engineering, the *link motion* of an engine is said to be in mid gear when the arrangement is such that neither backward nor forward motion is possible.

Midship.—Of or pertaining to, or being in, the middle of a ship.

Midway.—In the middle of the way or distance; half way.

Mildew.—In carpentry, the growth of minute powdery fungus found in decaying timber; also called *dry rot*.

Mild Steel.—A class of steel of great tenacity and ductility which is an alloy of iron with a very small percentage of carbon; it has a crystalline structure and is weldable but cannot be hardened.

Mile.—An English statute mile, the standard in the United States, is equal to 1760 yards or 5280 feet, this is used for all land measurements. A nautical mile is the admiralty mile of 6080 feet (*a knot*); some authorities take it as 6080.26 feet, the value of a minute of latitude at the equator.

Mill.—1. A building fitted up with the machinery needed for a factory, as a flour mill, cotton mill, or a saw mill.
2. To cut with rotary tools.
3. To work ridges on the edge, as in coins.

Milled Head.—In machinery, the *circular head* of a set or adjustment screw, whose edge is cut into a succession of ridges to enable the fingers to grasp it without slipping.

Milled Screw.—A screw with a flat broad head knurled or roughened with serrated ridges to afford a firm grip for the fingers

Mill File.—A flat file used for draw filing, and lathe work; it is thinner than the ordinary hand file.

Mill Gearing.—In millwrighting, deriving its name from the old corn mills, and now comprising the heavy machine work of the millwright, embracing cog wheels, pulleys, shaft bearings, and belting.

Milling.—1. The grinding of wheat and other cereals into meal or flour for food purposes.

2. The grinding or disintegrating of ores to recover their metallic contents.

3. The shaping of metals by means of revolving tools or *milling cutters*.

Milling Cutters.—Circular cutters or discs of steel serrated around and along their edges, which are formed to an exact counterpart of the contour which it is desired to reproduce. They are used in a *milling machine*.

Milling Machine.—A machine tool operating on metals by means of a cylindrical revolving cutter with serrated edges or cutting teeth.

Million.—Ten hundred thousand (1,000,000); also used figuratively for an indefinitely large number.

Mill Man.—A man employed in a mill, generally in ironworks.

Mill Pick.—In flour milling, a tool like a double steel wedge mounted in a short handle and used to dress or sharpen the faces of millstones.

Mill Power.—In hydraulics, a mill power is a *unit* used to rate a water power for the purpose of renting it. The value of the unit varies in different localities.

Millrace.—In hydraulics, the sluiceway through which the water runs to a mill wheel.

Mill Rolls.—The merchant rolls of a rolling mill. They are employed for the production of finished iron from the puddled bar after it has been *cropped*, *piled* and *balled* or reheated. They are similar in the main to the puddle rolls; they consist of sets of roughing or billeting and finishing rolls, and are either *two high* or *three high*.

Mill Scale.—Magnetic oxide of iron, forming the scales found around a blacksmith's anvil. This is formed on iron or

steel wherever hammered or rolled in a heated condition, and in boiler making is removed from the plates by "pickling" them in a dilute solution of sulphuric acid.

Mill Spindle.—The vertical spindle supporting and driving the runner stone in a flouring mill.

Millstone.—One of a pair of cylindrical stones used in grinding. For flour mills, a *buhrstone* is used, the best coming from Normandy.

Millstone Grit.—A conglomerate, found at the very bottom of coal measures in England and the United States. Its grains run from the size of millet to several inches in diameter; some of the finer varieties are used for millstones, hence the name.

Millwright.—A mechanic employed in the installation or repair of machinery in a mill. In former days, a knowledge of carpentry, blacksmithing and lathe work was imperative in addition to the work of the fitter or erector, and in England and Scotland the millwright is apprenticed to learn all these branches.

Mine.—An excavation in the earth for the purpose of getting coal, ore, or metals; the term signifying that the hollowed workings are entirely underground, and approached by a shaft or tunnel.

Mineral.—1. An inorganic substance, generally solid, having a definite molecular structure and chemical composition, and further distinguishing physical characteristics, such as crystallization, cleavage, hardness, fracture, etc., any inorganic body forming part of the earth's crust; anything dug out from the earth.

2. Having the character of a mineral, or obtained from a mineral source.

Mineral Oil.—Oil of mineral origin is either petroleum, or some of its distillates. It comes from oil wells, or oil-bearing shale. Its widest use is for illuminating purposes, but it is also extensively employed for lubrication of machinery in situations where it is impracticable to use animal oils, such as sperm, or lard.

Mineral Wool.—Ironworks slag, blown like spun glass, by a jet of compressed air through its molten substance, into a fluffy material resembling cotton wool, it forms an excellent non-conductor of heat. Also known as *silicate cotton*.

Miners' Dial.—A compass provided with a magnetic needle, a horizontal dial graduated to 360°, and sights through which stations may be observed in order to ascertain the direction of lines. The instrument is used for underground surveying, hence its name.

Miners' Inch.—In mining laws of various regions, the quantity of water that will pass an opening of one square inch in twenty four hours, under a head of six inches.

Minimum.—A term in arithmetic, the least quantity; opposed to *maximum*.

Mining.—The act or process of excavating or working mines; the business of a miner.

Mining Case.—A frame of a shaft or gallery in a mine, composed of four pieces of plank.

Mining Engine.—Any engine used in mining; as, a mining pump or mining locomotive.

Mining Engineer.—One who follows that branch of the engineering profession which relates not only to the selecting, testing, opening, and working of mines, but also to the science of extracting metals from their ores.

Mining Machine.—A coal cutting machine.

Mining Pump.—A steam pump specially designed to effect drainage in mines, other than the large pumps working in the shaft through spear rods. A type usually designated by this term has externally packed plungers with "pot" valves, to secure the greatest accessibility of parts; in many coal mines, owing to the acidity of the waters, wooden lined pistons and cylinders have to be employed. Also called *sinking pump*.

Minium.—A bright red lead oxide used principally as paint. Called also *red lead*.

Minor.—Less in number, quantity or extent; opposed to *major*. A minor axis is the shorter one of an ellipse.

Minor Axis.—In geometry, the axis of a conic section perpendicular to the *major axis*; as, the shorter axis of an oval.

Mint.—A place where money is coined by the authority of the government.

Minuend.—The number from which another is to be subtracted.

Minus.—In mathematics, the sign of subtraction (—), also used to denote a negative quantity.

Minute.—1. The sixtieth part of an hour sixty seconds; a small portion of time and duration; the 1440th part of a day.
2. The 60th part of a degree; a unit of angular measure indicated by the sign (').

Mire.—Deep mud, wet spongy earth.

Miscellaneous.—Mixed; consisting of several sorts; promiscuous.

Misdo.—To do wrong; to commit a fault; as, to misdo a job of work.

Misfiring.—A failure to ignite on the part of the explosive mixture within the cylinder of an internal combustion engine.

Misfit.—The act or state of fitting badly; as, a misfit in joinery.

Mislay.—To lay an object in a place not recollected; to lose.

Misle.—To rain in very fine drops, like a thick mist; to mizzle.

Mismake.—To make or form amiss; to spoil in making.

Mispickel.—In mining, arsenical iron pyrites, from tin white to steel gray in color, frequently containing cobalt or nickel; found in Cornwall, Saxony, Bohemia, U. S., etc.

Mississippi River Gauge Cock.—A try cock, which is really a conical valve within a cock shell. It has no handle or wheel but is opened by means of pressure on the end of the spindle, the valve being seated, after opening, by means of an internal spring or the pressure on its inner surface.

Mist.—Visible watery vapor, suspended in the atmosphere at or near the surface of the earth; fog.

Mistake.—An unintentional error of conduct; a fault in judgment; a misunderstanding.

Mite.—A small weight; one twentieth of a grain; a very little quantity or particle.

Miter, Mitre.—1. An angle of 45° , or, more properly, the joint formed by the ends of two pieces, as of moulding, each cut off at an angle of 45° , and matching together so as to form a right angle.

2. The term is also applied to pieces meeting at any other angle, and matching together on a line bisecting the angle.

Miter Board.—In carpentry, a board used for cutting mitred joints. Locks are screwed on a plain board at angles of 45° with its edge, thus forming a guide for the plane, which is laid upon its side, as in shooting.

Miter Box.—In carpentry, a trough with vertical saw cuts through the sides, at an angle of 45° with the length, or at any given angle, to guide the saw in cutting work to form miters.

Miter Bricks.—Bricks moulded to form internal or external angles, which are more convenient than chopping ordinary bricks to shape.

Miter Coil.—A heating coil in which the pipes are attached to two manifolds at right angles to each other, thus giving each pipe a mitre bend.

Miter Joint.—The junction of two bodies at an equally divided angle; as, at the corner of a picture frame; a piece cut at an angle; mitering.

Miter Saw.—A short wood saw, with a back to stiffen the blade, used in cutting miters within a box.

Miter Square.—An instrument or tool beveled with an arm immovable at an angle of 45° for striking lines on stuff to be mitred; used in carpentry, etc.

Miter Wheels.—In machinery, a pair of bevel wheels, of equal diameter, working together, usually with their axes at right angles.

Mixed Mathematics.—Treats of magnitudes or quantities as subsisting with material things; opposed to Pure or Abstract mathematics, which treats of mathematics without regard to things.

Mixed Number.—In arithmetic, a number consisting of a whole number and a fraction.

Mixed Quantity.—In mathematics, anything to which mathematical processes, as addition, etc., are applicable,

and are of different characters; opposite to *pure mathematics*.

Mixing Chamber.—The chamber in which gas and air are mixed in due proportions for internal combustion engines; a carburetor.

Mixing Machine.—In steel making, an apparatus for producing a uniform steel from several furnaces, resembling a huge cradle of iron, lined with refractory material, which is oscillated on trunnions by means of hydraulic cylinders. Charges often amounting to hundreds of tons of molten steel are run into the machine, and the rocking not only mingles them properly, but the agitation liberates occluded gases which would tend to make unsound ingots or castings.

Mixing Tube.—A species of tubular carburetor in which the gas or olefiant vapor and air are mixed for use in an internal combustion engine.

Mixing Valve.—A valve or device through which air and gas are admitted to form an explosive mixture.

Mixture.—That which is mixed or mingled; a mass or compound consisting of different ingredients blended together.

Mizzen Mast.—The rear or after mast of a ship.

Mizzle.—Mist; fine rain.

Mobility.—The property of being easily movable, quick response to slight impulse or force.

Model.—That by which a thing is to be measured; pattern; example.

Modern.—Pertaining to the present time, or time not long past; as, a modern practice.

Modulus.—A term used in mathematics, mechanics and physics, being "a number or quantity that measures a force or effect," hence, the primary signification of modulus is a measure; the modulus of a machine means the same as the efficiency of it. The modulus of a machine is a formula (or measure) expressing the work a given machine can perform under the condition under which it has been constructed; the words mode, model, mould are kindred terms, all formed from the same root word and meaning somewhat the same. Plural, moduli.

Modulus of Elasticity.—In mechanics, the measure of the elastic force of any substance.

Modulus of Machine.—In mechanics, a formula expressing the work which a given machine can perform under the conditions involved in its construction; the relation between the force exerted upon a machine by the moving power, and that yielded at the working points, either constantly if its motion be uniform, or in the interval of time which it occupies in passing from any given velocity to the same velocity again if its motion be variable.

Modulus of Rupture.—In mechanics, the measure of the force necessary to break a given substance *across*, as a beam.

Moil.—1. A miners' tool, made of drill steel, like a short crowbar, pointed at the end and worked by hand.

2. A term used in weaving.

3. In glass making, the metallic oxide adhering to the glass which is knocked from the end of the blow pipe.

Moisture.—A slight sensible wetness, dampness, or humidity.

Mold.—A form or matrix for shaping anything in a fluid or plastic condition, especially when the shape is to be rendered permanent by cooling or hardening; as, in making cast iron of various forms; the manufacture of terra cotta ornaments, etc.; also spelled *mould*.

Molecular Attraction.—The attraction exerted by one molecule upon another, as apart from the attraction of gravitation. The cohesion of bodies and chemical affinities are examples of this force, the tensile strength of a bar of steel being due to the attraction which its molecules have for each other.

Molecular Force.—A force exerted between molecules but only at infinitely small distances.

Molecule.—The smallest particle in which a substance can exist in the free or uncombined state, or the least part into which a compound can be subdivided and yet retain its characteristic properties. The molecule of any compound must contain at least two atoms, and generally consists of many more, some molecules containing a very large number indeed.

Molybdenum.—A hard, silver white, metallic element; it is harder than silver and fuses with difficulty in a blast furnace; it has come into use as a constituent of the air hardening process, in treating steels.

Moment.—In mechanics, the measure of a force, by its effect in producing rotation, especially motion about a fixed point. Also, generally, a very small period of time and a point of time.

Moment of Inertia.—In mechanics, said of a rotating body; the *sum* of the products of the mass of each particle of matter of the body, into the *square of its distance* from the axis of rotation. Called also *moment of rotation* and *moment of the mass*.

Momentum.—The quantity of motion in a moving body, which is always proportional to the quantity of matter multiplied by the velocity; impetus.

Money.—Stamped coin; any currency usually and lawfully employed in buying and selling as the equivalent of specie; as, bank notes and the like.

Mongrel Threads.—In screw cutting, threads which do not conform to the accepted standards, as regards pitch and diameter.

Monitor.—In hydraulic mining, a large nozzle through which the jet of water passes.

Monitor Lathe.—A turret lathe; so termed in the United States, because Ericsson's "Monitor" was the first turret ship.

Monkey.—In mechanics: 1. An iron block or ram with a catch, used in pile driving, etc., raised by ropes and let drop.

2. In glass making, a small glass melting crucible.

3. A ram, tup or heavy mass used as a hammer in engineering purposes, such as starting a screw propeller from its shaft, etc.

Monkey Engine.—The ordinary apparatus for pile driving, including the frame or derrick, the monkey or ram and the appliances for hoisting and tripping the latter.

Monkey Rope.—A rope fastened to the waist belt, when working in dangerous positions, as of a sailor working over the side of a vessel, etc.

Monkey Wrench.—A form of spanner whose jaws are adjustable by means of a

screw, so that it can be used on bolts, nuts, or plugs of varying sizes. It should properly have been named "moncky" from its inventor, Charles Moncky, who sold his patent for a comparatively small sum, and who lived during the later years of his life in the Williamsburg section of Brooklyn, N. Y.

Monoclinical.—In mining, a term applied to strata which are tilted upward on a slope, and then continue their previous horizontal course without a descent on the other side.

Month.—One of the twelve portions into which the year is divided; the twelfth part of a year.

Monthly.—Continued a month or performed in a month; done, payable, etc., once a month or every month.

Moorings.—Buoys anchored in suitable positions, between which a vessel may be moored, usually head and stern, thus obviating anchoring and preventing swinging.

Mooring Shackle.—In ships, a large shackle or clevis to make fast lines or warps to buoys, piers, etc.

Mooring Swivel.—A device to enable a ship to ride to two anchors and swing without fouling; it consists of a heavy double chain over the bows, swiveled to each of the two anchor cables.

Mop.—An implement for washing the floors or the like, made of a piece of cloth or a collection of thrums, or coarse yarn, fastened to a handle.

Mordant.—1. Biting; severe.

2. In dyeing, serving to fix colors.

3. Any substance, as alum, or copperas, which, having a twofold attraction for organic fibers and coloring matter, serves as a bond between them, and thus gives fixity to dyes.

4. In gilding, any sticky matter by which gold leaf is made to adhere.

Morland, Sir Samuel.—Born 1625, died 1695. An English diplomat, mathematician and inventor. Though greatly concerned with affairs of state, he had time to develop several successful inventions which won for him considerable distinction. He invented the speaking trumpet of which a specimen can still be seen in Cambridge, England, and two calculating machines; but his most important work was in connection with hydro-

statics. After 1660, he was occupied in experimenting with water engines of various kinds, perfecting in 1674 a plunger pump in which was first introduced the gland and stuffing box. He also suggested the use of steam for ship propulsion. He left several published works on mathematics and hydrostatics.

Mortar.—A cementing material consisting of a mixture of lime, sand with water, used to bind together bricks or stones into structures. It "sets" or hardens in the air, and not under water, its setting consisting in the changing of the hydrate of lime into the carbonate by the absorption of carbonic acid from the atmosphere. This naturally is a slow process. Hardening also depends upon the crystallization of the mortar, and is greatly facilitated by using uniform sand of sharp and angular nature, as lake or river sand. Good mortar, if free from dampness, hardens from year to year, and becomes as strong as the material it unites.

The best known and most reliable mortar used in building construction is composed of three parts of clean *sharp sand*, free from earthy matter, and one part of *freshly slaked lime*.

Mortar Mill.—A machine used for mixing or combining lime and sand to make mortar. The earliest type was the pug-mill, worked by horse power, which has been succeeded by machines revolving on a horizontal axis, which are also used very largely for mixing concrete.

Mortgage.—A conveyance of property, upon condition, as security for the payment of a debt or the performance of a duty, and to become void upon payment or performance according to the agreed terms; also, the written instrument by which the conveyance is made.

Mortice.—The same as mortise, and often spelt this way by stonemasons.

Mortise.—A hole or cavity cut in any material to receive the end or tenon of another piece.

Mortise Chisel.—A stout socket chisel, tapering to a cape point, used by joiners and carpenters in cutting out mortises in woodwork.

Mortise Gauge.—A sort of double scratch gauge with two sliding bars, thus marking both sides of a mortise at one setting.

Mortise Gearing.—In shafting, a train of spur gearing in which an inserted tooth or mortise wheel drives an iron one, to insure a silent drive.

Mortise Wheel.—A spur wheel having inserted teeth of wood, usually apple tree or hornbeam.

Mortising Machine.—A woodworking machine for cutting slots or mortises in parts for the reception of the gains or tenons.

Mosaic.—Of, or pertaining to the style of work called mosaic; formed by uniting pieces of different colors; variegated; also composed of various materials or ingredients.

Moss.—A bog; a morass; a place containing peat.

Motion.—1. This word is employed to denote a change of position in relation to some assumed fixed point.

2. In machinery, the arrangement of parts to produce a particular result or effect; as, a *valve motion*.

Motion Block.—In mechanical engineering, the *crosshead* of a steam engine.

Motion Plate.—In a locomotive, the transverse frame on an inside cylinder which supports the guide bars and affords a bearing for the intermediate valve spindles.

Motive Power.—The force applied by some exterior agent which causes motion to take place or work to be done. It is used in a restricted sense to denote the whole business of providing haulage on a railway, as we speak of the superintendent of motive power.

Motor.—Any apparatus designed to produce motion or do work: a prime mover. The application of the term is usually restricted to two senses:

1. Small secondary movers working by means of energy transmitted from a central source of power, as in electric, hydraulic or pneumatic systems of power transmission.

2. Internal combustion or electric engines, used to propel vehicles on ordinary roads (motor cars); or internal combustion engines employed for propulsion of small craft or for working single vehicles on railways.

Motor Boat.—A small craft propelled by a motor. Sometimes, though incorrectly called *power boat*.

Motor Car.—An automobile; a vehicle for use on ordinary roads propelled by a prime mover, usually an internal combustion engine.

Motor Cycle.—A bicycle driven by an explosion motor, usually in conjunction with pedaling on the part of the rider.

Motor Shaft.—The main or crank shaft of a motor.

Mottled Iron.—A quality of cast iron intermediate between the gray and the white varieties, both in point of texture, crystallization, and the state in which its carbon occurs, a portion being in the *combined* and a portion also being in the uncombined or *graphitic* state.

Mould Board.—1. In founding, a board or plate on which the pattern rests in the flask, while the sand is being rammed. The mould board is made of wood, composition, or plaster of paris, and serves to form the joint for small and intricate castings.

2. That part of a plough which turns over the furrow cut by the coulter and plowshare; it is adjustable so that the furrow may stand on edge, lie against those previously cut, as in lap furrowing, or be turned completely over.

Mould Facing.—In a foundry, facing sand; also applied to meal powdered soapstone, and chalk when similarly applied.

Mould Loft.—A covered floor, painted black, on which are drawn, full size, the various curves of a vessel, from which are taken the scribe board, and various trammels and templates for use of the workmen.

Moulder.—In an iron foundry, a workman who makes moulds and castings; a founder.

Moulders' Clamp.—A flask clamp, used in moulding in a foundry.

Moulders' Floor.—That part of a foundry devoted to the proper operations of moulding, as distinct from furnaces, trimming shops, etc.

Moulding Machine.—1. In founding, a contrivance to expedite the making of moulds, consisting of tables on which the flasks are placed with the plate pattern between them, and cope and nowel are both rammed by the machine.

2. A woodworking machine, in which a revolving cutter profiles ornamental moulding, after the manner of a milling machine for metal.

Moulding Sand.—A mixture of sand and loam used in founding.

Moulding Shop.—That portion of the foundry department of an iron works devoted to the process of moulding.

Mountings.—That by which anything is prepared for use; equipment; as, the mountings of a steam boiler, meaning the safety valves, water gauges, etc.

Mouse Trap.—In well drilling, a fishing tool, having a latch or valve in the bottom of a cone, designed to recover small objects from the bottom of a drilled well.

Mousing.—In rigging, a lashing or shackle passed around the shank and point of a hook to prevent its spreading or unhooking.

Mousing Hook.—A hook having a mousing.

Mouth.—The opening or orifice of a pipe, furnace, ladle, or similar cylindrical or hollow vessel.

Mouth Blow Pipe.—An instrument by which a blast or current of air is driven through the flame of a lamp or candle, so as to direct the flame and concentrate the heat on some object.

Mouth Piece.—That part of a boiler furnace through which the fuel is introduced and often some air. The lower side of the mouth piece is the *dead plate*.

Movable.—1. That which can be moved or shifted from place to place.

2. In the plural, *movables*, it is applied to personal property, not fixed, as distinguished from houses and lands.

Movable Head.—In ammonia compressors, owing to the necessity for keeping clearance down to the smallest possible limits, frequently $\frac{1}{8}$ inch only, and there being danger of the cylinder head being knocked out when wear has taken place; some firms have fitted a loose or movable head or cover to the compressor, held in place by stout springs, so that, should a "knock" take place, the head will yield and no mishap occur.

Mower.—An agricultural implement; a reaper specially adapted for hay and other grass crops, also called *reaping machine*.

Mss.—Abbreviation for manuscript or writings.

M Teeth.—In tools, saw teeth shaped like the letter *M*. Used in cross cut saws for heavy and rough work.

Mucilage.—A gummy substance found in the roots, bark and seeds of many plants; as, the bark of the elm, quince and flax-

seeds, etc. It is largely used in the arts and manufactures.

Muck Bar.—In iron making, a rough bar made by only one passage through the rolls.

Mucker.—In American copper mining, a *trammer*; one who loads cars or tubs underground with broken rock or iron ore.

Muck Rolls.—In a rolling mill, the first pair of rolls.

Mud.—Soft earth deposited from water in which it has been dissolved and mechanically suspended. All large rivers bring down great quantities of earth which is deposited as mud in bars where they enter the ocean; in time the river is closed to navigation unless a channel is kept open by dredging. Many ancient river sea ports finally declined in importance from their inability to prevent the filling up of their harbors. The river Ganges annually brings down mud enough to cover the State of New Jersey four inches deep.

Mud Drum.—In steam engineering, a cylinder beneath a steam boiler, into which sediment and mud held in solution in the water can settle for removal.

Mud Ring.—In a locomotive type boiler, an iron bar of rectangular section which is interposed between the internal firebox and the external wrapper plate at the base of the firebox, the whole being riveted up with through rivets. Known also as *foundation ring*, *firebox ring*, etc.

Mudsills.—The foundation timbers of a structure placed directly on the ground; in well boring, those heavy squared transverse timbers on which the framing of the rig and derrick rest.

Muffle.—1. A reverberatory furnace used for heating or annealing boiler plates, sectional iron, etc.

2. A *D* shaped oven, perforated with ventilating holes, in which cupels and assays are placed and thrust into the furnace, being thus protected from ashes or smoke while subject to the influence of the flame and air currents, also under observation of the assayer.

Muffled Safety Valve.—In steam engineering, one in which the waste steam blows through diaphragms perforated with small holes, acting as a silencer.

Muffler.—A vessel, chambered and partitioned within, the diaphragms being usually perforated with small holes, designed to silence or reduce the noise, occasioned by the blowing off of steam from a safety valve or the exhaust gases from an engine, by forcing the steam or gas to expand gradually.

Mule.—In manufacturing, a spinning machine in which the rovings are delivered from a series of sets of drawing rollers to spindles placed on a carriage called a mule, which travels away from the rollers while the thread is being twisted, and returns toward the rollers while the thread is being wound.

Mule Jenny.—A machine for spinning cotton, wool, etc., into yarn or thread and winding it into cops.

Mule Pulleys.—An arrangement of guide pulleys, similar to that employed in a mule, whereby a belt can be utilized for a drive around a corner, or to replace bevel wheels.

Muley Saw.—A mill saw (from the German, *muehle*, a mill); a straight vertical saw, not strained in a gate or sash, but held in clamps which move within guides on an upper and lower rail; this saw is used for boards, etc.

Mullions.—In architecture, upright bars or columns of stone, dividing a window opening into two or more lights.

Multi-cylinder.—Having many similar cylinders. An automobile motor is said to be multi-cylinder as it possesses two or more cylinders, the object being to insure even turning and less vibration.

Multi-cylinder Engine.—In engineering, a steam engine having more than one cylinder.

Multiple.—Manifold; having many parts or relations.

Multiple Stage Compressor.—An air compressor which operates in more than two stages.

Multiplicand.—In arithmetic, a number which is to be multiplied by another, called the multiplier.

Multiplication.—Finding the amount of one number increased as many times as there are units in another. The number to be multiplied or increased is called the multiplicand. The multiplier is the number by which we multiply. It shows how many times the multiplicand is to be increased, the answer is called the product.

Multiplier.—1. A number by which another is multiplied.
2. A machine for performing operations in multiplication.

3. A flat coil of conducting wire used as the coil of a galvanoscope.

Multi-stage Centrifugal Pump.—One having numerous impellers or fans arranged in series, the delivery of one going to the suction of the succeeding one. By these means, it is possible to deliver to as great a height as with a reciprocating pump, retaining the advantages of rotary motion.

Multi-tubular.—Containing many tubes; a boiler is said to be multi-tubular when it possesses many fire tubes, as a locomotive, or a Scotch marine boiler.

Muntz Metal.—Named after Muntz of Birmingham, England, its inventor. It consists of 66 per cent. copper and 40 per cent. zinc; is very ductile, can be forged when hot, and has an ultimate tensile strength of 49000 lbs. per square inch.

Murdock, William.—Born 1754, died 1839. An English engineer. In 1784 he built a model locomotive which operated successfully, and in 1785, an oscillating engine; in 1792 he began experimenting with coal gas for illuminating purposes; he perfected the process a few years later, so that it was employed successfully in 1802, and by 1805 gas had come into general use as an illuminant. He also employed compressed air as a source of power, and made various improvements in the steam engine.

Muriatic Acid.—Hydrochloric acid or "spirits of salts."

Mushet Steel.—A self hardening tool steel containing about $8\frac{1}{2}$ to 9 per cent. of tungsten, and $1\frac{1}{2}$ to 2 per cent. of manganese. It is remarkably hard and tough, being especially suitable for turning chilled rolls. It cannot be worked when cold except by grinding, and should be forged to shape by hammering, care being taken not to break it, reheating the tool several times while it is being dressed, and finally, when to its proper shape, hammering it lightly until the color has faded.

Mushroom Anchor.—One in which the flukes are replaced by a bowl or hemispherical head, thus gripping in any position; used for anchoring buoys, etc.

Music Wire.—Fine, tenacious, steel wire such as is used for the strings of musical instruments; much employed for measuring long distances or for setting out center lines, on account of its thinness, strength, and the small amount of sag it requires when stretched taut.

Mute Pulley.—A pulley used to guide a belt and adjustable to various positions upon its stand.

N.—The fourteenth letter of the English alphabet.

Nadir.—That point of the heavens directly opposite the zenith; the point directly under the place where we stand; hence, the lowest point; the place or time of greatest depression.

Nagging.—Fault finding; teasing; persistently annoying; scolding, fretting.

Nail.—A small pointed piece of metal, usually with a head, to be driven into a board or other piece of timber, and serving to fasten it to another timber, or left projecting; as, from a wall, to hang anything upon. The different sorts of nails are named either from the use to which they are applied, or from their shape; as, shingle, floor, ship carpenters' and horseshoe nails, roseheads, diamonds, etc.

The following table will show the length of the various sizes and the number of nails in a pound; they are rated "3-penny" up to "20-penny." The first column gives the name, the second the length in inches, and the third the number per pound:

3-penny,	1 inch,	557 nails per lb.
4 "	1 1/4 "	353 "
5 "	1 1/2 "	232 "
6 "	2 "	167 "
7 "	2 1/4 "	141 "
8 "	2 1/2 "	101 "
10 "	2 3/4 "	98 "
12 "	3 "	54 "
20- Spikes	3 1/2 "	34 "
	4 "	16 "
	4 1/2 "	12 "
	5 "	10 "
	6 "	7 "
	7 "	5 "

Nail Bit.—In carpentry, a boring tool used to cut across the grain of the wood, previous to nailing, thus preventing the wood from splitting when the nails are driven.

Nailer.—One whose occupation it is to make nails.

Nail Headed.—In machinery, having a head like that of a nail; formed so as to resemble the head of a nail; as, in iron turning, some lathe tools are used called *nail headed tools*.

Nail Headed Moulding.—An ornament used in Norman and Gothic architecture, consisting of a series of low, four sided

pyramids, resembling the heads of large nails; called also, *nail head moulding*, or *nail head*.

Nail Set.—A driving punch used by carpenters to hammer the head of a nail below the surface of the wood where it is intended to cover it up; as, with putty. They are made with round, square, and cupped points.

Name.—The title by which a person or thing is known or designated; as, an individual or class.

Nap.—Woolly surface; as, of felt, of cloth, of some plants, and the like; external covering of down, or short, fine hairs or fibers combed out of the substance of anything, and lying smoothly in one direction.

Naphtha.—A light, volatile, inflammable oil, distilled from bituminous shale and petroleum, used as a solvent in the making of paints, the firing of oil engines, etc. Naphtha is a Greek name applied originally to mineral oils of any description.

Naphtha Engine.—A marine engine having a superposed coil boiler and using naphtha both for fuel and power.

Naphtha Launch.—A boat whose motion is produced by a propeller which is driven by a naphtha engine.

Naphthaline.—More properly *naphtha lene*. A complex hydrocarbon derived from coal tar, which contains 8 to 10 per cent. of it, and melts at 176° F., forming large colorless crystals on cooling. It is used to increase the illuminating power of coal gas; is employed in the preparation of many dyes; is a valuable antiseptic, and is objectionable to many insects, hence its use in moth balls, sheets, etc., to protect from the ravages of moths. The formation of its crystals within the pipes of a gas works, due to the cooling of the products of distillation, is one of the great difficulties with which gas engineers have to contend.

Napierian Logarithms.—In mathematics, those logarithms of which the base is 2.7182818; so called from NAPIER, the inventor of logarithms. Also called *hyperbolic logarithms*.



Napier's Compasses.—A drawing compass which is constructed with folding legs to be carried in the pocket. The working points are pivoted to the main legs, and are double ended and reversible on their pivots. One pivot leg carries a point and pencil at opposite ends, the other a point and a pen, so that two points, or a point and a pencil, or a point and a pen can be used at pleasure.

Napping.—The act or process of raising a nap, as on cloth.

Narration.—The act of telling or relating the particulars of an event; recital.

Narrow.—Of little breadth; not wide or broad; having little distance from side to side.

Narrow Gauge.—In railways a term applied when the width between the rails is less than the standard of 4' 8½".

N. A. S. E.—Abbreviation for National Association of Stationary Engineers.

Nasmith, James.—Born 1808, died 1890. A Scottish mechanical engineer, distinguished as the inventor of the steam hammer. Having established a business for the manufacture of machine tools, he studied the improvement of them, developing a remarkable series of valuable inventions; he invented the steam hammer (1839); a hydraulic punch; a steam pile driver; hydraulic press; the turntable; the skew face punch, and other devices of equal value. He was also interested in astronomy, inventing a reflecting telescope (1827) and publishing a work on the moon (1874).

Native.—In mining, said of any metal when found free and uncombined with another substance; as, free silver, free copper.

Native Copper.—Copper which is mined in the metallic state. It occurs in the district of Lake Superior and is highly esteemed on account of its purity, which renders it superior to any other copper for electrical purposes.

Natural.—In conformity with the laws of nature; real, not artificial.

Natural Draught.—The draught produced by the atmosphere rushing by its own pressure into a chimney wherein air or gas, rarefied by heat, has produced a partial vacuum by rising.

Natural Gas.—That obtained from wells, etc., in Pennsylvania, Ohio, and elsewhere, and largely used for fuel and illuminating purposes; it is chiefly derived from the coal-measures.

Natural Philosophy.—Originally the study of nature in general; in modern usage, that branch of physical science, commonly called *physics*, which treats of the phenomena and laws of matter; the science which treats of the laws of the material world.

Nauseate.—To affect with, or as with a feeling of nausea; to feel great aversion for; cause to loathe; as, seasickness.

Nautical.—Of or pertaining to ships, and consequently to seafaring persons and things, and to the arts and science of seamanship and navigation.

Nautical Measures.—In navigation, measures of or pertaining to the art of navigation, or to ships; as, a *nautical mile*.

TABLE:

60 geograph- ic, or 69.16 statute miles	= 1 degree	{ of latitude on a me- ridian, or of longi- tude on the equator.
360 degrees..	= {	the circumference of the earth.
1.15½ statute miles	= {	1 geographic mile, used to measure distances at sea.
3 geographic miles	= 1	nautical league.

A statute mile is 5,280 feet. It is the standard of "long" measure adopted by the English for land measurements. A nautical mile or *knot* is 6,080 feet or 1.152 statute miles. Some writers contend that the word *knot* should only be used to denote a rate of speed.

Naval Architect.—A professional man who plans and designs ships and vessels of every description, not alone for war but also for commerce, pleasure and other purposes.

Naval Brass.—An alloy consisting of 62% copper, 37% zinc, 1% tin; it does not corrode under the action of sea water and can be forged hot.

Naval Engineer.—An officer in class of captain or lieutenant, a graduated civil engineer, in charge of works at navy yards, etc., belonging to the navy department.

Naval Stores.—Provisions, medicines and general supplies; ropes, sails and cordage; chains and anchors; cleansing and polishing materials and paints; hardware, brushes and ship chandlery, generally; in fact, any gear or supplies for use on shipboard, whether the vessel be naval or commercial. Ammunition and the like are known as *warlike stores*.

Nave.—1. In architecture, the central or main body of a church, lengthwise, extending from the chief entrance to the choir or chancel.

2. The hub of a wheel into which the spokes are inserted.

Navigation.—The science of directing the course of vessels so that they may sail from one part of the globe to another. It includes knowledge of the mariners' compass, with its attendant errors and the corrections necessary; observations of the heavenly bodies, so that the ship's position may be obtained thereby, and knowledge of the various dangers and obstacles to be encountered on a given route, so that a safe course may always be steered. The actual handling of the vessel, in any given circumstance, comes under the head of *seamanship*, as do all the necessary attention and repair to the rigging, sails and fabric of the vessel.

Navy.—1. A form of excavating machine.

2. An English laborer, employed in building canals, railways, etc.

3. An artificial waterway, a canal.

N. E.—Abbreviation for North East.

Neap Tide.—Also called *neaps*. A tide with minimum rise and fall occurring one or two days after the first and third quarters of the moon. The rise and fall being diminished on account of the attraction of the sun opposing that of the moon.

Neat Line.—In civil engineering, a line to which work is to be built or formed.

Neat's Foot Oil.—A lubricant obtained from the feet of neat cattle; i. e., oxen, cows, etc.

Neat Work.—Work built or formed to finished trim lines.

Neck.—1. A narrow or smaller portion connecting two larger parts, similar to the human neck.

2. The contracted part of a bottle, or anything resembling in appearance a bottle neck.

3. A journal or bearing, more especially when the journal is turned down to a lesser diameter than the main portion of the shaft.

Neck Moulding.—In architecture, a small convex moulding surrounding a column at the junction of the shaft and capital.

Neck Piece.—In a *pulsometer*, the branched casting in which the controlling ball valve works, fitting on top of the two ventricles of the pump: it is closed by the *neck-cap* which receives the steam supply pipe.

Needle.—1. Anything resembling in shape a sewing needle; a pointer or index; as, the needle of a telegraph instrument or of a pressure gauge.

2. A slender, pointed instrument used in sewing.

3. A rod used in making a small hole for blasting purposes.

4. A prickler for any purpose, resembling a needle in appearance.

5. In erecting, a needle is the piece of horizontal timber going through the wall, supporting it, and resting in turn on the heads of the shores.

Needle File.—A small file, of various sections, used by jewelers and instrument makers; the tang is prolonged and rounded so as to serve as a handle.

Needle Lubricator.—An oil vessel whose cork or plug fits into the passage where lubrication is desired, this plug being traversed by an easy fitting needle which rests upon the shaft. The needle prevents a free flow of oil, but its vibration occasions a small steady stream to trickle down it into the journal.

Needle Points.—1. Points of needles, used to fasten fine cabinet work together; as, dowels.

2. Needles used as points for compasses, dividers and other mathematical instruments, to avoid tearing holes in the paper. The needles are usually locked in the point by means of a nut and bolt, so as to be easily renewable.

Needle Valve.—A valve consisting of a long fine point to its spindle, the point just fitting into a hole which its motion opens or closes. Needle valves are much used in carburetors, etc.

Needle Wire.—A piece of iron wire used for piercing a foundry mould with small holes for the escape of gas, generated in casting.

Negative.—1. The opposite to positive; used as such in many instances in science.

2. In electrical apparatus, the pole or direction towards which the current is supposed to flow, that pole which wastes away the least in an arc lamp or during electrolytic processes.

3. In spinning and weaving, take-up attachments actuated by springs or weights; those moving parts not actually driven by direct connections.

Negative Lap.—Paring away the inside or exhaust edges of a slide valve to promote earlier exhaust. This opens communication between the two ends of the cylinder at one portion of the stroke, but the advantages gained in some cases outweigh this defect. Also known as *minus inside lap*.

Negative Quantity.—In mathematics, that which cannot be increased; anything to which mathematical processes are not applicable

Negative Slip.—In navigation, a term which is applied to the speed of a ship's screw when the velocity of the vessel is greater than it should be according to the theoretical calculation based on the principle that the screw works in an unyielding body. It is due probably to the mechanical principle called *vis viva* of the current which follows the vessel's wake.

Negative Term.—An algebraical or arithmetical term preceded by the sign —.

Negligence.—Habitual omission of that which ought to be done.

Negotiate.—To treat or bargain with another for an agreement; as, he negotiated for five cartloads of sand.

Neighborhood.—The region lying near where one is or resides; adjoining or surrounding dwellings collectively.

Neishout.—A mahogany-like wood, the sawdust of which causes violent sneezing (whence the name). Also called *sneezewood*.

Net.—1. A fabric of twine, thread, or the like, wrought or woven into meshes.

2. A fabric woven of brass and copper wire into meshes and used for clarifying purposes, screening, etc.

3. Gain, as clear profit in business affairs.

4. Free from other substances; not including incidental or foreign matter; as, boxes, coverings, etc.; also, free from charges, deduction, etc., as *net weight*, etc.

Net Register.—A marine term denoting the tonnage capacity of a ship, after making legal deductions for machinery and accommodation.

Netting.—A fabric of openwork; a net, as:

1. A hammock netting.

2. A mosquito netting.

3. A screen or grating at the upper end of a locomotive smokestack, to prevent the escape of cinders.

Netting Machine.—A machine producing, in imitation of handmade netting, a fabric knotted at the intersection of the threads: a netloom.

Nettle Cloth.—A kind of thick cotton stuff, japanned, and used as a substitute for leather.

Net Weight.—The actual weight of merchandise after making allowances for packages, or wrappings; the difference between *tare* and *gross weight*. Also spelled *nett*.

Neutral.—1. Not engaged on either side; not taking part with or assisting either of two or more contending parties; indifferent.

2. Having neither acid nor basic properties; unable to turn red litmus blue or blue litmus red.

Neutral Axis.—In building, the part of a girder which is neither in compression nor tension.

Neutral Equilibrium.—The balance, or equilibrium, of a body so placed that when moved slightly it neither tends to return to its former position nor depart more widely from it; as, a perfect sphere or cylinder on a horizontal plane.

Neutral Line.—In mechanics, when a beam is subjected to flexure, there is a longitudinal center line which is neither in compression nor extension, and is therefore subject to no straining action. The part where this line cuts any particular section is termed the *neutral axis* of the beam; since also the tensile and compressive forces diminish as the neutral axis is approached, girders and girder-like structures are frequently lightened out in their central portions. In a beam of uniform section, the neutral line corresponds with the central line of the cross section. In beams of other sections it will be the mean of bending sections.

Neutral Position of Slide Valve.—The central position.

Neutral Tint.—In drawing, a purplish gray color sometimes used to distinguish *cast iron* in sectional drawings.

Newcomen, Thomas.—Born 1663, died 1729. An English blacksmith and inventor. He invented an atmospheric steam engine, patented 1707, which was a combination and improvement over all previous designs, incorporating many elements making up the modern steam engine; it proved to be a practical engine and was first used for pumping purposes.

Newel.—In carpentry, the post at the foot of a stair which supports the handrail.

Newton's Laws of Motion.—1. If a body be at rest, it will remain at rest; or if in motion, it will move uniformly in a straight line until acted upon by some force.

2. If a body be acted upon by several forces it will obey each as though the others were non-existent, and this whether the body be at rest or in motion.

3. If a force act to change the state of a body with respect to rest or motion, the body will offer a resistance equal and directly opposed to the force. In other words, every action is opposed by an equal and opposite reaction.

N. H. P.—Abbreviation for nominal horse power. The term originated in the time of Watt, and was used to express approximately the power of an engine as calculated from its diameter, assuming the mean pressure in the cylinder to be 7 lbs. above atmosphere.

Nib.—1. In locksmithing, a separate adjustable limb of a permutation key.

2. In hardware, the handle of a scythe snathe. It has a ring slipping on the snathe and tightened by a bolt or wedge.

3. In pen making, one of the points of a pen or a small pen adapted to be placed in a holder for use; also called *steel pen*.

Nick.—To cut in nicks or notches; to make a nick or nicks in; as, to nick a stick; to break in pieces; as, by cutting nicks or notches in.

Nickel.—A hard white metal capable of a high polish. Its specific gravity is 8.9, and it melts at about the same temperature as iron. It is magnetic but is not easily oxidized, hence its use in *nickelplating*. An addition of 5 per cent. of nickel increases the tensile strength of steel one-half; the metal is used in *nickelplating*, as mentioned above, and alloyed in equal proportions of copper and zinc ($\frac{1}{2}$ of each) it constitutes German silver, much employed for mathematical and drawing instruments.

Nickel Alloy.—Any alloy containing nickel; especially, a metal of German origin, from which tubes are made for gas engine igniters.

Nickelplating.—The act or process of electro depositing a coating of nickel upon articles made from some other metal, to protect them from corrosion and permit them to be given a highly polished appearance.

Nickel Silver.—An alloy of nickel, copper, and zinc, usually called German silver.

Nickel Steel.—Ordinary soft steel to which has been added a small percentage of nickel: it has been found that the addition of about three percent. (3.16 to 8.32) produces the most favorable results.

Nicking.—In blacksmithing, cutting a shallow groove around or across a bar of iron or steel so that it will break at the required place when struck; as, with a heavy blow.

Nigger.—1. A steam capstan used to haul a Mississippi River steamboat over a snag or bar.

2. A log carting device in a saw mill.

Niggerhead.—In a locomotive, the T pipe connecting the dry steam pipe with the branches to either cylinder.

Night Glass.—A telescope or binocular whose lenses are arranged to concentrate as much light as possible so as to adapt the instrument for night observations.

Night Latch.—A kind of latch for a door which is operated from the outside by a key, called a *night key*.

Nine.—The number next following eight and preceding ten; the sum of five and four.

Nineteen.—The number greater by one than eighteen; the sum of ten and nine.

Ninety.—Nine times ten; one more than eighty-nine; as, ninety men; the product of nine times ten.

Nip.—To enclose and compress tightly between two surfaces or edges which are brought together or closed; to pinch; to close in upon.

Nippers.—Small pinchers for holding, breaking, or cutting.

Nipping Lever.—In mechanics, a lever which is so constructed and adjusted, that on moving its longer arm around the fulcrum, the shorter arm on the opposite side of the fulcrum bites or nips the periphery of a smooth turned wheel, and the greater the pressure brought to bear upon the lever, the greater the nipping power. Moving the lever in the contrary direction releases the bite immediately. The principle is employed in the construction of what is known as the *silent feed*.

Nipple.—1. Any small protuberant cylindrical piece, perforated axially.

2. A gas jet burner.

3. A small tubular nut used to fix a spoke in a bicycle wheel.

4. A piece of pipe not exceeding 12 inches in length, threaded at each end. This is the pipe-makers' definition; in pipe fitting, any short length of pipe with a male thread on either end; nipples are classified according to length; as, *close*, *short* and *long*.

Nipple Holder.—A device or sort of chuck to receive the end of a nipple which is first threaded, to save the thread from damage while the other end is being screwed.

Niter, Nitre.—A biting, white nitrate; niter is used in the arts under the name of *saltpetre*, especially in the manufacture of gunpowder.

Nitrate.—A salt formed by the action of nitric acid on a base.

Nitrate of Silver.—An acid prepared from silver by the action of nitric acid, evaporating the solution to dryness, fusing and recrystallizing from water. It is used in the preparation of other silver salts, and as a cauterizing agent, organic matter turning it to black metallic silver; also known as *lunar caustic*.

Nitrate of Soda.—The commercial name for sodium nitrate, also known as Chili saltpetre, occurring in immense quantities just below the surface in Peru and Chili.

Nitric Acid.—A powerful, corrosive acid, composed of one weight each of hydrogen and nitrogen and three of oxygen. It is extensively used in the arts in dissolving metals, also known as *aqua fortis*.

Nitro.—A combining word, with others indicating the presence of nitrogen, as *nitrol*, *nitrophenol*, etc.

Nitro Gelatin.—An explosive compound formed by dissolving finely subdivided guncotton in nitroglycerin and containing over 90 per cent. of the latter. It can only be fired by a powerful detonator.

Nitrogen.—A gas possessing mainly negative properties, being odorless, tasteless, colorless, non-combustible, and a non-supporter of life or combustion; it is an element found in the mineral kingdom, as in the air (forming four fifths of its volume), in the vegetable kingdom, as a common constituent of plant tissue, and in the animal kingdom, as in the various tissues of the body. Nitrogen has been liquefied; one cubic foot at 32° temperature weighs a trifle less than one ounce.

Nitroglycerin.—A violent liquid explosive formed by spraying one part glycerin on a chilled mixture of three parts nitric and five parts sulphuric acids. The nitroglycerin floats on the top of the acid mixture, is drained off, washed with an alkaline solution, and then filtered. It is many times more powerful than gunpowder and can be fired whether wet or dry, but its fluidity hinders its use for many purposes. To avoid this difficulty

and to diminish the danger of transport, a very porous siliceous earth is mixed with nitroglycerin forming *dynamite*. Dynamite can only be exploded by percussion.

Nitrous Oxide.—In chemistry, hyponitrous oxide or protoxide of nitrogen; also called laughing gas from the exhilaration and laughter which it sometimes produces when inhaled.

No. or Num.—Abbreviation for number.

Nob.—In locksmithing, the keeper or box into which the lock is shot.

Nobbing.—In metallurgy, the process of hammering or rolling a puddled ball in order to convert it into bar or sheet iron.

Noddle Pin.—In machinery, a pin which has the top turned downward.

Node.—1. A knot, or protuberance resembling a knot.

2. In geometry, a double point on a curved surface; a point of intersection of curved lines:

Nodule.—An irregular rounded lump or ball of earthy or mineral matter in which shape many minerals are found.

Noils.—1. Short waste fibers and knots of wool or silk separated from the long fibers in combing.

2. Waste silk.

Nominal Horse Power.—An expression which originated in the time of Watt, to express approximately the power of a steam engine as calculated from its diameter, assuming the mean pressure in the cylinder to be 7 pounds above the atmosphere.

Nonagon.—A plane figure enclosing nine angles, and therefore having nine sides.

Non Condensing.—In steam engineering, not condensing; discharging the steam from the cylinder at a pressure nearly equal to or above that of the atmosphere, and not into a condenser.

Non Condensing Engine.—One which discharges its steam directly into the atmosphere. The difference between the condensing and non-condensing engines, with equal pressure of steam and expansion, is solely, that the condensing engine has the advantage of the effect produced by the vacuum.

Non Conductor.—Any material which is a poor conductor of heat or electricity, and is therefore available as an insulator for electrical apparatus or as a covering for steam pipes, etc., to prevent radiation, or as insulating material for refrigerators to retard the transfer of heat from the atmosphere.

Non Return Valve.—An automatic valve, sometimes a hinged clack, but more frequently of the same pattern as an ordinary stop valve disconnected from its spindle: it opens with the pulsation of a pump to pass the water, and closes as soon as the flow ceases, preventing a backward rush of the water under pressure. A boiler feed check is the most familiar example of a non-return valve.

Noon.—The middle of the day; midday; the time when the sun is in the meridian; twelve o'clock in the day time.

Noria.—In hydraulics, an Egyptian or Syrian scoop wheel, consisting of a water wheel with revolving buckets or earthen pitchers, which raise the water from the stream in which the wheel is set, and deliver into a trough near its upper circumference.

Normal.—In accordance with rule, principle, or established custom.

Normal Pitch.—In mechanics, the pitch of a screw wheel taken perpendicular to the directions of the teeth, as distinguished from the circumferential pitch. In screw gears, gearing together, the normal pitches must be equal.

North.—That one of the four cardinal points of the compass, at any place, which lies in the direction of the true meridian and to the left hand of a person facing the east; the direction opposite to the south.

North Pole.—That point in the heavens, or on the earth, ninety degrees from the equator, toward the north.

Nose.—In machinery, generally, any projecting part, as a mandrel nose or the front of a spindle.

Nose Bit.—In carpentry, a bit used for boring wood whose section is a convex and concave curve, roughly though not exactly of a half circular form, and which is provided with a nose or lip at the cutting point from the withdrawal of the core from the wood.

Nosehole.—In glassmaking, a small opening in a furnace before which a globe of ground glass is held and kept soft at the beginning of the flattening process.

Notation.—In arithmetic, a system of figures, signs or characters to express a number, or numbers, as in the following table of Arabic and Roman notations:

TABLE.

Arabic	Roman	Names
0		Naught.
1	I.	One.
2	II.	Two.
3	III.	Three.
4	IV.	Four.
5	V.	Five.
6	VI.	Six.
7	VII.	Seven.
8	VIII.	Eight.
9	IX.	Nine.
10	X.	Ten.
11	XI.	Eleven.
12	XII.	Twelve.
13	XIII.	Thirteen.
14	XIV.	Fourteen.
15	XV.	Fifteen.
16	XVI.	Sixteen.
17	XVII.	Seventeen.
18	XVIII.	Eighteen.
19	XIX.	Nineteen.
20	XX.	Twenty.
30	XXX.	Thirty.
40	XL.	Forty.
50	L.	Fifty.
60	LX.	Sixty.
70	LXX.	Seventy.
80	LXXX.	Eighty.
90	XC.	Ninety.
100	C.	One hundred.
200	CC.	Two hundred.
300	CCC.	Three hundred.
400	CCC.	Four hundred.
500	D.	Five hundred.
600	DC.	Six hundred.
700	DCC.	Seven hundred.
800	DCCC.	Eight hundred.
900	DCCCC, or CM.	Nine hundred.
1000	M.	One thousand.
2000	MM.	Two thousand.

Notch.—A nick or indentation; a hollow or recess cut in anything, more especially in carpentry, for the reception of another part.

Notch Board.—In carpentry, the board which receives the ends of the steps in a staircase.

Notching.—In carpentry, a method of joining portions of a frame together, by means of recesses cut in one timber for the reception of projections on another, either by dovetails or square or half joints: *halving* and *scarfing* are parts of it.

Notch Wire Gauge.—The usual pattern of wire gauge provided with notches, corresponding in width to the different numbers or thicknesses of wire, disposed around the circumference of a plate of circular or other convenient form.

Notice.—An order communicated to one; especially, a written or printed instruction or warning; as, to post a notice.

Nowel.—In founding, the lower flask in a mould; also termed *drag*.

Nozzle.—A word derived from nose or snout, hence the projecting vent of anything; as, the nozzle of a pair of bellows, or the nozzle of a fire hose.

Nugget.—A lump, a mass, especially a lump of gold found in alluvial deposits. Several of considerable size have been found in Australia; one, the largest on record, weighing over 184 pounds and netting when melted \$46,625.

Null.—Something which has no force or meaning; void; useless.

Numb.—To deprive of the power of sensation or motion; to deaden; to stupefy.

Numbers.—Treat of magnitude or quantity. A simple number is one which expresses one or more units of the same denomination. A compound number expresses units of two or more denominations of the same kind; as, 5 yards, 1 foot, 4 inches is a compound number; but ten oxen or five dollars, is a simple number.

Numerals.—1. The figures and characters employed to denote numbers.

2. The words used in counting to express cardinal numbers.

Numeration.—The act or art of dividing off a series of figures according to their values, and expressing them in words;

the act or art of reading numbers, especially as written in the scale of ten, by the Arabic method.

Numerator.—In a vulgar fraction, the figure above the line.

Numismatics.—That branch of knowledge which treats of coins and medals, embracing their history, artistic merit, description and classification. Ancient coins are frequently called medals, but the distinction between coins and medals in modern times is principally one of use, the former being intended for circulation as a medium of exchange, while the latter are struck to commemorate some person or event. Coins are usually round and so are medals, but the latter are often larger than coins and may be of square or rectangular shape.

Nut.—1. A small block of metal or wood, containing an internal screw, used for retaining or tightening a bolt, and the like.

2. A projection on each side of the shank of an anchor, to secure the stock in its place.

Nut Brown Color.—In blacksmithing, the color at which most turning tools for metal, particularly for wrought iron, are tempered. It corresponds with a temperature of about 540 degrees Fahrenheit.

Nut Lock.—In machinery, the device adopted for securing a nut in place so that it shall not slacken back and become loose in consequence of vibration. There are many such devices, as *pins, wedges, set screws, keys*, etc.

Nut Tapping Machine.—A machine tool in which the tap is revolved by a chuck, the nuts being fed to it in a saddle or steady. When the shank of the machine tap is full of nuts, the tap is released from the chuck, the nuts dropped off, and the tap reset for a fresh lot.



O.—The fifteenth letter of the English alphabet.

O'.—A prefix to Irish family names which signifies *grandson* or *descendant* of, and is a character of dignity.

Oak.—The most important of all hard woods, with a strong grain, often showing a handsome figure; that obtained by sawing the wood quarterly being termed *quartered oak*. Its color is from light grayish yellow to dark brown, and it takes a high polish. Oak is employed on heavy work where great strength and durability are required; as, in piles, ship building, and building constructions, especially where exposed to the weather; also for furniture and inside decoration.

Oakum.—Shredded rope or hemp fiber; tow.

Oar.—A long shaft with the handle at one end, and a blade or spoon at the other, for rowing, sculling, or steering a boat.

Oar Lock.—A device of wood or metal for keeping an oar in place, and also serving as a fulcrum in rowing. Also called *row lock*.

Oarsman.—One who rows or is skilled in rowing.

Obelisk.—An upright, four sided pillar gradually tapering as it rises, and terminating in a pyramid. Egyptian obelisks are commonly covered with hieroglyphic writing from top to bottom.

Obfuscate.—To darken; to obscure; to becloud; hence, to confuse; to bewilder.

Object.—That which is affected by an action or upon which any movement or effort is expended.

Objective.—The lens or combination of lenses which forms the object glass of an optical instrument, particularly a microscope.

Object Staff.—In surveying, a staff the same height as the level, forming a sight to be viewed from in determining levels. A leveling staff consists of a graduated strip sliding in the dovetail groove of an upright bar, and provided

with a cross bar to whose intersecting point the eye of the leveler is directed. The said bar is raised or lowered until it meets the level, and the height is read on the staff. The sliding is for purposes of extension

when the level is above the top of the main bar.

Oblate.—In geometry, flattened at the poles; as, the earth is an oblate spheroid.

Obligation.—That which obligates or constrains; the binding power of a promise or contract; to firmly hold to an act or duty.

Oblique.—Not erect or perpendicular; not extending at right angles from the base; slanting; inclined.

Oblique Angle.—One acute or obtuse, in opposition to a right angle; deviating from the perpendicular or from a right line by any angle except a right angle.

Oblique Area.—In marine engineering, the area of the face of a propeller blade; also called *screw area*.

Oblique Cone.—One where the point lies without a perpendicular from the center of the base.

Oblique Lines.—Those which are neither parallel nor perpendicular to each other.

Oblique Section.—In mechanical and architectural drawing, a section taken obliquely or at an angle across the drawing of an object. The precise direction of an oblique section should be indicated by a dotted line and reference letters.

Obliquity of Connecting Rod.—In mechanical engineering, this signifies the angle made by the connecting rod of a steam engine when the crank pin is at any point of its path except at the dead centers, the extreme upper and lower portions of its path, respectively. The effect of the obliquity is to cause the slide valve to open the ports unequally at each end, the port being closed and opened a little earlier at one end than at the other. Partly for this reason the connecting rod is always made as long as circumstances will permit in order to diminish the amount of obliquity.

Oblong.—1. A figure having greater length than breadth.

2. In mathematics, having one principal axis longer than the other.

Observance.—The act or practice of observing or noticing with care; performance, usually with a sense of strictness and fidelity.

Observation.—1. The act or fact of seeing and taking note of; watching for any occurrence or phenomenon and recording the same.

2. An act of scientific observing, together with measurements of the thing observed; as, a nautical observation of the sun for the purpose of calculating a ship's position.

Observation Car.—1. On railways, a car having an extended platform and large windows to afford passengers a view of surrounding scenery; it is generally placed at the rear of a train.

2. A similar car, or one having an observation end, for officials to inspect the track and structures.

Observatory.—1. A place or building designed to that end and fitted with suitable instruments for making and recording observations of natural phenomena, as of meteorology or magnetism, but more especially of astronomy.

2. A lookout or signal station placed at such an elevation as to command an extensive view.

Obstruction.—That which stops or bars the way; as, an obstruction to navigation.

Obtuse Angle.—Greater than a right angle or more than 90°.

Occlusion of Gases.—In physics, red hot metals allow of a passage of gases through their substance; the gases are then said to be *occluded*. Occlusion plays an important part in the carbonization of iron. The exact method by which this is effected is doubtful, but probably the carbonic oxide is dissociated and deposits carbon in the pores.

Occupy.—To take up room or space; to cover or fill; use or employ in an exclusive manner.

Ocean.—1. The large body of water that covers about two-thirds the earth's surface.

2. One of the immense tracts of water into which the great ocean is regarded

as divided; as, the Atlantic, Pacific, Indian, Arctic and Antarctic *Oceans*.

Ocean Steamer.—A seagoing steam vessel; especially one for passenger service in distinction from a *freighter*.

Ochre.—A name applied to a class of natural earths, which are used largely as paints.

Octagon.—A polygon bounded by *eight sides*.

Octagonal Miter.—A miter between two pieces shaped as regular octagon, or between any two pieces at an angle of 135°.

Octahedron.—A solid geometrical figure bounded by eight equilateral triangles.

Octave.—Consisting of eight; eight.

Odd.—Not divisible by two without a remainder; not capable of being evenly paired, one unit with another; as, 1, 3, 7, 9, 11, etc., are *odd numbers*.

Odd Pitch.—In machinery, the pitch of a screw is said to be odd when it is either not of the same pitch, or not some aliquot part of the pitch of the leading screw of the lathe in which it is being cut. Thus with a leading screw of two threads to the inch, three, or nine or eleven threads would be odd pitches.

Odometer.—An instrument attached to the hub of a wheeled vehicle to keep a record of the distance traveled. It is also used for purposes of surveying in districts where there are good roads; in this case the wheel is drawn by hand.

Odontograph.—In instruments, a scale to simplify the marking out of wheel teeth. Tables of appropriate numbers are given upon the scale for wheels of various pitches, by which suitable radii for the teeth of those wheels are obtained, the centers of the radii being given by the setting of the slant edge of the scale against the radial lines running from the center of the wheel through the pitch lines.

Off.—1. Denoting distance or separation; as, the shop is two miles *off*.

2. Denoting the action of removing or separating; as, to cut *off*.

Offer.—A proposal to be accepted or rejected; a sum offered; a bid.

Offhand.—Instant; ready; extemporaneous; as, he replied *offhand* to the proposal to work.

Office.—The place where a particular kind of business is transacted; as, the office of the works.

Offset.—In masonry, a comparatively thin place in the length of a wall. In pipe fitting, a bend in a pipe bringing one part out of, but parallel with, the line of another.

Offset Bit.—A well boring tool so made that it cuts eccentrically on one corner only, thus making a hole larger than itself. A tool that can go through a length of casing and enlarge the hole ahead of it so that the tubing can follow.

Offset Glass.—In steam engineering, a glass lubricator cup flattened on one side for closer application.

Offset Pipe.—A pipe constructed with a bend or offset to carry it around an obstacle, and return to its original direction.

Offside.—The right hand side in driving; the farther side.

Ogee Arch.—A pointed arch, each of the sides of which has the curve of an ogee; that is, a moulding, the section of which is the form of the letter S with the convex part above.

Oil.—A substance expressed or drawn off from various animal and vegetable matter. It is insoluble in water, but is sometimes soluble in alcohol, and always in ether. It has been found to consist of glycerin, a sweet, thick, syrupy liquid, united with animal and mineral acids. Stearin and margarin prevail in the solid fats and olein in the liquid oils; also a mineral oil.

Oil Bath.—A bath or reservoir of oil, in which revolving parts subject to excessive friction are partially or wholly immersed, to provide them with constant lubrication. Worm gearing, when run at a high speed, is often immersed in an oil bath.

Oil Bilge.—A separate and oil tight division of the bilges, into which drain scupper and drip pipes from the fire-room installation of a steamer burning liquid fuel.

Oil Boats.—In machinery, the receptacles for the waste oil at the ends of the bed slides of planing machines, etc.

Oil Box.—A journal box that holds a supply of oil, provided either with tubes

for worsted syphons, or with small drip valves to pass the oil into the lubricating ducts.

Oil Burner.—An atomizer for spraying liquid fuel, and injecting it into the furnace.

Oil Burning Locomotive.—One in which liquid fuel is used instead of coal or wood. The oil is usually sprayed into the fire-box by means of a steam jet, and burns with a white heat while in this finely subdivided state.

Oil Can.—A portable receptacle for oil; a can with a spout whence the oil feeders can be filled. The small oilers used by woodworkers and cyclists are also termed oil cans.

Oil Car.—A tank car for the conveyance of petroleum or other oils; usually consisting of a cylindrical reservoir mounted upon an ordinary steel underbody, the tank being strutted and stayed against shifting.

Oil Cellar.—In a locomotive, a cavity formed in some types of axle or journal boxes, underneath the space occupied by the axle packing; it collects what oil and dirt runs down at the dust guard.

Oil Cloth.—Cloth oiled or painted for covering floors, and other uses.

Oil Collector.—In machinery, a vessel provided to catch superfluous oil from bearings either to prevent the soiling of adjacent parts or for re-utilization. It usually consists of a tray of some kind.

Oil Cup.—A lubricator; especially, a small cup or vase screwed into a machine part at the upper end of a lubricating duct to receive the oil from the feeder, a cap being fitted to exclude dust.

Oil Engine.—An internal combustion motor using the vapor from petroleum, either crude or illuminating, instead of gasoline, etc.

Oiler.—1. One who or that which oils; as, a workman employed to oil engines or machinery.

2. Any automatic device for oiling machinery; as, an oil can.

3. A vessel for transporting oil.

Oil Feeder.—The hand oil can carried by an oiler to lubricate the machinery, especially on shipboard.

Oil Filter.—An apparatus for purifying oil collected in savealls underneath the bearings of a machinery installation. The gathered oil is settled, freed from water and filtered clear of impurities, thus rendering it fit to use again.

Oil Fuel.—Oil used as fuel for steam generation, metal working, etc.

Oil Gas.—1. Gas formed from petroleum by spraying it over heated cast iron cylinders, the gas being afterwards compressed nearly to a liquid, for use in buoys, illuminating railway vehicles, etc.

2. Petroleum gasified in retorts for admixture with water gas, to give the proper illuminating power to the latter.

Oil Grooves.—In machinery, small semicircular or nearly semicircular grooves cut in the internal faces of brasses and on the sliding surfaces of machines for the due distribution of the oil for lubricating purposes. The oil grooves are cut diagonally across the bearing surfaces.

Oil Gun.—A large cylindrical oil feeder with a long spout and a spring plunger, as used by locomotive engineers for squirting oil into the less accessible portions of the machinery; as, the eccentrics, etc., between the frames.

Oil Hardening.—In blacksmithing, the hardening of steel, effected by quenching it in oil instead of in water. The effect of oil hardening is the less rapid cooling of the steel, with a resulting greater elasticity and tensile strength and an absence of extreme hardness.

Oil Heater.—A vessel in which various seeds are heated so that a larger proportion of oil may be expressed from them.

Oil Hole.—A hole drilled down to a bearing to form a channel for oil used for lubrication. Oil holes are countersunk at the top, the better to receive and retain the oil, and are usually covered with a pivoted disc when not in use. The difference between an oil hole and an oil cup or a lubricator, is that the former conveys a temporary supply of oil to the bearing, the latter holds a store in reserve, so that while the former requires constant renewal the latter is only supplied at long intervals.

Oiling.—1. To apply oil to the bearings of a machine.

2. In wool carding, the process of applying oil to the wool as it enters the carding machine, to prevent felting in the subsequent operations, by means of a

reservoir traveling laterally across the entering wool.

Oil Mill.—In milling, a machine used for obtaining the oily substance of grain, seeds, fruits, etc., by pressure, rolling, grinding, tearing or cutting processes.

Oil of Turpentine.—Crude turpentine which is obtained from various species of the pine tree in Russia, France, Germany, and the United States. Incisions are made into the wood through the bark, the turpentine being collected in suitable vessels, these having their contents frequently removed to avoid loss of the more volatile matter. The gathered resins and turpentine are distilled with water until nothing further passes over, the oil of turpentine being found floating on the top of the water in the condensers from which it is easily skimmed. The residue is resin, which may be used as it is, or be separated into resin oils and pitch by redistillation at higher temperatures.

Oil Press.—A crushing machine used for pressing out the oil from seeds, nuts, fruits, etc.

Oil Pump.—In lubrication, a small force pump used to provide a constant and positive supply of oil under pressure to a bearing, as being more reliable and therefore preferable to a lubricator, which acts by gravitation or by displacement only.

Oil Reservoir.—A closed container for oil when used for fuel or gas making, to prevent accidental fire or explosion.

Oil Saver.—A device used in drilling oil wells, so as to save oil when finishing the hole; it usually consists of a rod working in a stuffing box on the tee which closes the casing.

Oil Separating Machine.—A device used in machine shops for separating oil from chips from lathes, screw machines, etc. It consists of a circular pan arranged to revolve on a vertical shaft and placed inside a concentric casing. The chips are placed in the pan and the oil separated by the centrifugal force due to the rotation.

Oil Separator.—In refrigeration, etc., a vessel, provided with baffles, etc., similar to a catch water in a steam pipe and so arranged; it is an oil saver.

Oil Shale.—Shaly rock containing petroleum in paying quantities.

Oil Skin.—Cloth rendered waterproof by oil.

Oilstone.—A stone of fine grain used for sharpening tools; so called because oil is used with them as a lubricant. Most of those used in the United States are called Washita or Arkansas stones and are of a white color. Turkish stones are used for fine edges, such as razors and surgical instruments, and are of a slate grey color.

Oil Temper.—In steel working, a temper obtained in steel by quenching it in oil.

Oilway.—In machinery, an oil hole; a groove in a bearing surface for the flow of oil.

Oil Well.—1. An artesian well bored for petroleum.

2. A receptacle formed in the base of the framing of certain types of engines, catching the oil thrown off from the moving parts, and usually supplied with a small pump which forces the oil over the same parts again.

O. K.—An abbreviation for "all correct". It originated in an early day from the use, by a prominent railroad official, of the letters "O. K." supposing "Ol Korect" was the proper spelling of "all correct". From this small circumstance began the use of this universal sign of approval and comprehension.

Old Man.—A handy tool used by machinists. A shop term.

Olefant.—A term signifying producing or yielding oil.

Olein.—A colorless oily liquid compound, the chief part of fatty oils; in its pure form it constitutes olive and almond oils.

Olive Oil.—Oil expressed from the fruit of the olive, grown in Mediterranean countries. It is used both for food, and as a lubricant.

Oliver.—In blacksmithing, a foot power hammer used mainly for forging bolts and studs.

Omit.—To leave undone; to forbear or fail to perform or to make use of.

Omnibus.—A long four-wheeled carriage, having seats for many people; from a word *omni* denoting *all, every, everywhere*.

One.—1. A single unit, as 1.

2. Any person; a person or body; as, what *one* would have well done, *one* should do *one's* self.

"On Wind".—Said of a blast furnace stove, when it is imparting its stored up heat to the blast on its way to the furnace, also *on gas*.

Onyx.—A kind of quartz, resembling agate, made up of layers of different colors, often sharply defined. Varieties which are brought from Algeria and Mexico are now used largely for decorative finish, building purposes, etc.

Oolite.—A limestone composed of small grains, more or less spherical in appearance, each formed of concentric coats of calcium carbonate around a nucleus, usually a grain of sand; used for building, and valued on account of the ease with which it may be worked and its soft and pleasing color. Also known as *oolitic freestones* and *Indiana marble*.

Ooze.—To discharge slowly; to flow through something or leak out imperceptibly; a gentle flow.

Opaque.—Impervious to the rays of light; not transparent; as, an opaque substance.

Open.—Not closed, allowing free ingress and egress.

Open Belt.—A driving belt which proceeds in a direct line from the top of one pulley to the top of another, without crossing.

Open Car.—In railways, a passenger vehicle having curtained sides, used in suburban or short distance excursion traffic.

Open Cut.—In civil engineering, an opening through a hill for a railroad, distinguished from a tunnel.

Open Hearth Furnace.—In steel making, a reverberatory furnace, in which the hearth forms a bath, wherein pig iron and ore are melted together with steel scrap, forming a peculiarly mild and homogenous steel, suitable for boiler plates and general forgings.

Open Hearth Process.—A method of making steel in large quantities from pig iron and ore, by melting the materials in a bath formed as the hearth of a reverberatory furnace. The furnace was originally invented by *Sir Charles Siemens*, whose name is inseparably associated with the process.

Opening Die.—In machinery, a screwing die used in screw machines in which the dies open and clear the thread on coming

to the end. The *turret* and die are then run back, so saving the trouble and possible injury to the thread due to the reversal of the solid dies. Most threads of medium and large size are cut with opening dies on screw machines.

Opening Machine.—In cotton manufacture, the same as *picker*.

Opening Out.—In structural ironwork, enlarging the diameter of a hole by means of a reamer, broach or driftpin.

Open Joints.—A term applied to the mode of jointing the broad plated portions of *foundry patterns*. Since patterns are enclosed frequently for several hours in damp moulding sand, the moisture acting on the wood causes it to expand, with the result, in the case of wide stuff, of increasing its width, and if its width is confined by other timber attached thereto, of producing curving. Wide plates are for this reason jointed in narrow separate pieces, the edges of the joints remaining about $\frac{1}{4}$ of an inch open, so that local extension takes place without affecting the outside dimensions to any appreciable extent. Conversely, the making of open joints prevents the plate from curving or contracting by the after drying of the stuff. Timber jointed thus, is held together by cross strips or battens, or by some other portions of the pattern. Tight fitting *dowels* are often inserted to assist the jointing.

Open Mouth.—In machinery, a punch or *punching bear* is open mouthed, when both sides and front are free for the insertion of the work, as distinguished from *close mouth*. A term used in the punching of plates.

Open Sand Moulding.—In founding, the execution of simple casting, like that of pig iron or foundry boxes, where the mould is uncovered, and no flask is used.

Open Side Planer.—A planing machine with a housing on one side only, thus permitting large or irregular objects to be mounted upon the table.

Open Work.—In mining, an excavation similar to a quarry, where the getting of the mineral is done in the open air.

Operating Expenses.—In railways, the total cost, including labor, taxes, salaries, supplies, maintenance and depreciation.

Operation.—1. The state of being at work, or actively employed; as, the machinery is in *operation*.
2. Method of working; action; process.

Operator.—One who exercises skill or labor in the manipulation of a machine or implement; as, a telegraph operator.

Opisometer.—An instrument with a revolving wheel, for measuring a curved line, as on a map.

Opportunity.—Fit or convenient time; a time favorable for the purpose.

Opposite.—Standing or placed in front of, or over against something else.

Opposition.—The state of being opposed; also, a position confronting another, or a placing in contrast.

Optical.—Relating or pertaining to the organ of sight; as, the optic nerve.

Optical Square.—A surveyors' instrument for laying out perpendicular lines.

Optics.—The science which treats of the nature and properties of light and colors; of the structure of the eye and of the laws of vision; of the construction of instruments, such as telescopes, microscopes, etc.

Option.—The power of choosing; the right of choice.

Optional.—Left to one's wish or choice; depending on choice or preference; as, it is optional with you to go or stay.

Orbit.—1. In mechanics, the track or course of a wheel.
2. Course; path; especially one which returns into itself, as in astronomy the path of a planet or comet.

Order.—1. A right arrangement; proper or working condition; as, machinery in order, or out of order.
2. The state of being orderly; that is, with everything arranged neatly in a methodical and regular manner.
3. A style of architecture, originally classified according to the nature and ornamentation of a pillar, with its base and entablature.
4. A written or spoken command; a definite and authoritative instruction.
5. A demand for commodities, or a request to be supplied with the same, in the course of business.

Order Number.—The blank form on which orders for goods and merchandise are given, which are numbered consecutively.

Ordinates.—A term used in finding the mean effective pressure from an indicator diagram. The meaning of the word is "even spaces or divisions"; in other words, the card is divided by lines, a given distance apart, into a number of

even spaces. For ease in making this division, ten spaces are generally used which are enough for practical use.

Ore.—The native form of a metal, whether free or uncombined; as, gold, copper, etc., or combined; as, iron, lead, etc.; the deposit in which a metal is mineralized together with veinstone or gangue, whence it has to be mechanically freed by dressing, and chemically by smelting.

Ore Barrow.—A wheelbarrow with two wheels, one on either side, arranged to tip forward, such as is employed to carry measured charges of ore, fuel and flux for blast furnaces.

Ore Concentrating.—In mining, the process of sorting ores according to richness or to separate the metallic portions of powdered ores from the *gangue*. There are two processes, the dry and the wet. In the *dry process*, the main principle is a blast of air, carrying or blowing the ores according to their weight, the quantity of metal determining the relative weight. According to their weight, the ores fall down and are thus separated, the very light parts being blown away as dust. In the *wet process*, the ore is put in a machine which has a circular, concave grooved disk, with a continuous rotary motion. The ore and water are received at the center and carried by centrifugal force to the rim of the disk, the heavier particles settling in the *riffles*. The debris, separated by the current and constant agitation, is carried out by the sluice across the disk to the center, and is discharged through openings into the stationary circular sluice below.

Ore Furnace.—A reverberatory furnace, used for the melting of coarse metals. Its hearth is smaller than that of the calciner, while its grate is larger. The reason is that in the ore furnace the charge has to be raised to the melting point, while in the *calciner* it has to be roasted only.

Oregon Pine.—The most valuable timber tree of the Pacific coast. While it grows all the way from British Columbia to Mexico, it is at its best in Oregon and Washington. It is sometimes 300 ft. in height; wood, hard, strong and durable, and highly valued for masts and spars.

Ore Jigger.—In smelting and refining, a riddle or sieve shaken vertically in water, to separate the contained ore into strata, according to weight and consequent richness.

Organ.—In machinery, a part performing an essential office in the working of any complex machine; as, the cylinder,

valves, cranks, etc., are organs of the steam engine.

Organic.—The state of being organized; forming or belonging to a system or organized whole.

Organic Chemistry.—That which treats of the substances which form the structure of organized beings and their products, whether animal or vegetable, called also *chemistry of the carbon compounds*.

Organization.—The state of being organized, so that each part is, at once, end and means; applicable to the preliminary plans and arrangements pertaining to the beginning of an extensive business or building operations.

Organize.—To arrange or constitute in parts, each having a special function, act, office, or relation.

Organzine.—In silk manufacture, a kind of thrown silk of very fine texture; that is, silk twisted like a rope with different strands, so as to increase its strength.

Oriel.—A large bay or recessed window; as, in a hall, a chapel, or other apartment. It usually projects outwardly from the face of the wall, with a semi-hexagonal or semi-square plan, and may be of various kinds or sizes. When not on the ground floor, it is supported by a corbel, or bracket. Called also oriel window.

Orifice.—The mouth or aperture of a tube, pipe or other cavity; an opening; as, the end of a steam pipe. Steam acts like a liquid in flowing through an *orifice*, and the velocity of flow is regulated by the same fundamental laws that govern liquids.

Original.—That which precedes all others of its class.

Orlop Deck.—In shipbuilding, the lowest deck of a ship. The deck is below the water line.

Orthographic.—In geometry, of or pertaining to right lines or angles. Hence, in orthographic projection, the various projecting lines for a mechanical drawing are either vertical or horizontal, so that all lines and angles are *right*.

Orthography.—The art or practice of writing words with the proper letters; mode of spelling.

Oscillating Bearing.—A journal bearing, usually made in one piece, and bushed with bronze or white metal, which swings on trunnions in its pedestal, thus affording alignment to the shaft. Much used about conveyers, etc.

Oscillating Cylinder.—A form of paddle engine in which the piston rod is directly coupled to the crank, without the intervention of a connecting rod; the cylinder being mounted on trunnions to allow it to swing or oscillate, to accommodate the motion of the crank.

Oscillating Engine.—A simple form of engine, in which the cylinder turns or rocks on trunnions, and the piston rod connects directly to the crank. It was invented by James Watt in 1763.

Oscillating Stresses.—In mechanics, are those by which structures, or the members of structures are placed alternately in tension and compression; as, for example in counterbraced structures, subject to alternate moving loads. The conclusions deduced from the experiments in this direction show that when a bar is subject to these oscillations in stresses, the total stress on the bar is equal to their sum; that is, supposing a tensile stress of two tons and a compressive stress of two tons, alternately applied, the equivalent is a total stress of four tons.

Oscillation.—A moving backward and forward; vibration; swinging, like a pendulum.

Osier.—One of the species of willow whose flexible branches are used for wicker or basket work in the construction of jetties and levees.

Osmium.—A metal of the platina group. It is used in the arts as an alloy of iridium for the points of gold pens.

Otto Cycle.—The four phase cycle commonly employed in internal combustion engines, giving an impulse each alternate revolution or every fourth stroke.

After explosion: (1) the return or *exhaust* stroke of the piston expels the products of combustion from the cylinder; (2) the *suction* or next outward stroke draws in a fresh charge of gas or vapor with the properly proportioned dilution of atmospheric air; (3) the *compression* or return stroke which compresses the charge into the clearance preparatory to (4) the *explosion* which does work on the piston.

Oust.—To eject; to turn out; to remove; a putting out of possession.

Out and Out.—A shop term, signifying an outermost dimension embracing the

extreme extent of the dimension. Also called *over all*.

Outboard.—The side or end of anything on shipboard remote from the center line of the ship, the opposite of *inboard*.

Outbuilding.—A building separate from, and subordinate to, the main house.

Outcrop.—In mining, appearance at the surface, of any strata, mineral, or ore.

Outdoor Foreman.—In general construction, a person whose duty consists in general overseeing of outdoor work. He is held responsible for details and the work of the men.

Outfall.—In drainage, the open end of a drain, culvert, etc., where the discharge occurs.

Outfit.—A collection of tools, repair parts and supplies for the operation of any machine; a supply of necessary things for any undertaking or operation.

Outflow.—To flow out; efflux.

Outlay.—1. A laying out or expending
2. That which is laid out or expended, expenditure.

Outlet.—A passage or vent for escape or discharge; the place or the means by which anything is let out.

Outline.—1. The outer or exterior line which bounds anything; a line without shading.

2. To delineate in outline; to sketch or to make a rough draft of.

Out of Gear.—In machinery, wheels are said to be out of gear when their teeth are disengaged from one another, either in consequence of being drawn backwards until their points clear, or endways until their *flanks* are no longer in contact.

Out of Joint.—A term used to express disorder, confusion, etc.

Out of True.—A shop term, signifying inaccuracy of work. A winding piece of board or metal, or a wobbling or eccentric piece of the work is said to be *out of true*.

Output.—The quantity of anything manufactured, or produced in a works or mine during a stated period.

Outrigger.—1. A subsidiary canoe mounted on a framework to steady a catamaran.

2. A frame of V section supporting the rowlocks of certain rowboats and permitting longer oars to be used.

Outside Admission.—As applied to a slide valve when it admits steam in the customary manner; i. e., past its outer edges.

Outside Admission Valve.—A slide valve in which steam is taken in at the outer edges, and exhausted past the inner ones, through a central cavity.

Outside Calipers.—Gauging instruments for measuring the external sizes of cylindrical objects. They consist of two sickle shaped pieces of steel, hinged together at the straight part by means of a rivet and washers, the convex parts outwards; the points are set at a distance apart equal to the diameter of the piece to be machined, or are set to its diameter and the measurement read off by comparison with a rule.

Outside Cylinder.—In a locomotive, where the cylinders are disposed outside the frames, and the crank pins are set in the hubs of the driving wheels.

Outside Lap.—In steam engineering, the lap given to slide valves on the outside edges, as distinguished from *exhaust lap*. The amount of outside lap is a measure of the ratio of expansion of the steam, an early cut off implying a high ratio of expansion.

Outside Work.—Work executed outside a shop, in distinction to shopwork.

Outstroke.—In a gas engine, the forward stroke of the piston; that is, in a direction *away* from the ignition chamber.

Outward Flow.—In hydraulics, a turbine is said to have outward flow, when the water enters at the center and escapes radially through the revolving blades in an outward direction.

Outward Flow Turbine.—In hydraulics, a water motor consisting essentially of two horizontal rings of buckets, one ring being enclosed within the other, and its buckets or *chutes* becoming the guides to a column of water, which having descended by gravity under a definite head, is caused to impinge on the buckets of the outer ring and thus turn the wheel by reaction.

Oval.—1. An egg-shaped figure; an ellipse constructed with three axes, one of the

minor axes being shorter than the other.

2. A common term for an ellipse.

Oval File.—In machinery, a file whose cross section is elliptical or *oval*. Used sometimes as a *gulleting file*.

Oval Socket.—In well boring, a fishing tool used to slip over the ends of broken and lost poles, to grip so as to recover them.

Oven.—An enclosed chamber, externally heated, for drying, cooking or otherwise applying heat to its contents.

Overall.—A shop term, signifying the outmost dimension and embracing the full extent of the dimension. *Out and out* is an equivalent term.

Overflow Pipe.—A waste pipe fixed to tanks, etc., to take away excess of fluid when it has reached its proper level.

Overflow Valve.—In steam engineering, any valve by which surplus liquid is allowed to run away. Overflow valves are used in injectors and tanks.

Overhanging Boiler Front.—A method of mounting the ordinary tubular boiler, in which the boiler shell rests upon the cast iron front piece, the smoke box protruding beyond it and thus *overhanging* the furnace door.

Overhanging Pulley.—In millwrighting, a pulley which is attached to the projecting portion of an overhanging shaft.

Overhanging Shaft.—In millwrighting, an end portion of a shaft which projects beyond its bearing, being supported therefore in one direction only.

Overhaul.—1. To inspect carefully or to examine the conditions of; to haul over; also to examine, as accounts, item by item.

2. In navigation, to extend the blocks of a tackle from each other and to slacken the fall so that it may operate smoothly.

Overhauling.—1. In rigging, to pull on the leading part so as to separate the blocks.

2. In construction, a strict examination with a view to correction or repairs.

Overhead Heating.—A method of applying steam heat to workshops, etc.,

the pipes being disposed horizontally near the ceiling. This saves the pipes from forming an obstruction, prevents the accumulation of dust and waste material around the heaters, and does not occupy valuable floor space.

Overhead Pulley.—1. A small wheel or pulley running on a horizontal rail, to sustain the weight of heavy sliding doors.

2. A sash pulley placed above the pulley stile, the cord being fastened to the top rail of the sash. This gives more room for the sash-weight to work in, and does away with the opening in the stile, though it needs more head room than a side pulley.

Overhead Traveler.—In machinery, usually consists of a crab mounted on a gantry and worked either by hand, steam or electricity. The advantage of overhead travelers is that they leave a clear space for working underneath and travel up and down and across the shop without interfering with the operations on the floor. The gantry truss is carried on girders or beams at each side of the building.

Overheating.—Exposing to a degree of heat unnecessary for a given purpose, or causing damage by excessive heat; as, a firebox crown may become overheated through shortness of water, or steel may become burnt by being overheated in working in a forge.

Overhung Crank.—A crank with a single arm or web, as in small horizontal engines, used to transmit power on one side only.

Overhung Cylinder.—A type of steam engine cylinder which is bolted, without a pedestal, on the end of the framing, which forms the crank end cylinder head.

Overlap.—To lap or fold over, as one slate on a roof overlaps another.

Overloading.—Imposing upon any structure, vehicle, or ship, a greater weight than it is designed to bear.

Over Pressure.—In steam engineering, the pressure of steam in a boiler beyond that which it is designed to sustain. It is a relative term, depending on the capability of each boiler itself, so that while 140 or 150 pounds would not be overpressure in a new boiler of the locomotive type, 40 or 45 pounds would be overpressure in another boiler of bad design or a boiler not properly stayed.

Overshot Water Wheel.—The most efficient form of water wheel, in which the stream flows over the wheel, thus

utilizing nearly the whole of the height of the fall. These wheels are advantageously employed where the variation in the level of the head race does not exceed two feet. The velocity of the periphery should be from $4\frac{1}{2}$ to 6 feet per second, the velocity of the entering water being twice those figures. They run very badly in backwater, the available height should therefore be taken at no more than one foot above highest flood level of tailwater.

Overtime.—All time worked over the specified daily number of hours of labor, or according to some trade unions' rules: the time before or after the regular working hours as stipulated by agreement between employers and working-men.

Overwinding.—When in a mine shaft the cages are drawn up too high, bringing them up against the pit-head frame.

Owner's Risk.—Ordinarily a transportation company is responsible for any damage to merchandise which it transports, certain classes of goods, however, are so fragile or liable to injury that an extra rate is charged, unless the shipper will sign a "release" which is an agreement by which he assumes the risk of damage. The entry on the waybill is then marked "O. R.," signifying that the shipment is at "owner's risk."

Oxalic Acid.—An acid prepared in large quantities by the action of fused caustic soda or potash on sawdust; is a white crystalline substance, which has a strong acid taste, and is poisonous in sufficient doses. It is used in dyeing, calico printing, bleaching flax and straw, etc.

Ox Gall.—In drawing, a material used by draughtsmen to impart fluidity to their colors.

Oxidation.—In chemistry, the act of combining with oxygen, or subject to the action of oxygen or of an oxidizing agent.

Oxide.—A compound of oxygen with another element; some oxides unite directly with water to form acids, others form hydroxides, while the peroxides, which contain a greater proportion of oxygen than the rest, have only very feeble acid or basic properties.

Oxide of Iron.—Ferric oxide, prepared from ferrous sulphate or green copperas by the action of great heat. The more calcined portions are graded to form the varieties of *crocus*, the softer portions are termed *rouge*, both being used for polishing.

Oxidizing.—The act of combining with oxygen of the atmosphere, or in water; as iron rust is formed by the oxygen attacking the metal and forming a compound similar to yellowish red sponge.

Oxygen.—In chemistry, the vital or life giving element in the atmosphere. Its presence is essential to combustion and it enters into combination with the carbon in fuel to produce heat in furnaces. In union with metals it forms oxides.

Oyster Shells.—In smelting, sometimes used as a *flux* in iron melting in the cupola, in place of limestone.

Oyster Tongs.—A tool used for dredging oysters in deep water. It consists of a pair of rakes with the teeth inward and hinged, so that when the handles are drawn together and the implement is raised to the surface of the water, the oysters are held between the teeth.

Ozone.—In chemistry, a faint blue, gaseous substance obtained as an allotropic form of oxygen, containing three atoms in the molecule. It is a strong oxidizer, and probably exists in the air; by the ordinary tests it is liable to be confused with certain other substances; as, hydrogen dioxide, or certain oxides of nitrogen. It derives its name from its peculiar odor, which resembles that of *weak chlorine*.



P.—The sixteenth letter of the English alphabet.

π.—The Greek letter *pi*, universally employed in mathematics to denote the ratio of the circumference of a circle to its diameter. This is an irrational number 3.1415+ which has been calculated out to some 500 decimal places by various authorities. π is generally taken as 3.1416 or for mental arithmetic as $\frac{22}{7}$; the first ratio is sufficiently accurate for all practical purposes as, in a circle one mile in diameter, the error of circumference is barely $\frac{1}{16}$ inch too large.

Paage.—A toll for passage over another person's ground. Also written *peage* and *pedage*.

Pabulum.—Food; nourishment; hence that which feeds or sustains; as, fuel for a fire; that upon which the mind or body is nourished.

Pace.—The length of a step in walking reckoned from the heel of one foot to the heel of the other; ordinarily the *pace* is estimated at two and one half feet; but when measuring distances by stepping, the *pace* is extended to three feet.

Pachometer.—An instrument for measuring thickness; as, the glass of a mirror.

Pacific Type Locomotive.—In railway engineering, a locomotive having a four wheel front truck, six coupled driving wheels, and a two wheel trailing truck. Used for heavy fast passenger service.

Pack.—1. To supply or surround; as, a joint, with a substance or device to prevent leakage; to fill up a space in or around; as, a stuffing box to make it fluid tight; as, to pack a piston rod.

2. In mining, to hit light blows on the side of the keeve, to assist the ore to settle from the veinstone.

Packing.—A bundle or parcel. The term "original package" in commercial usage, and American constitutional law, has come to have a recognized meaning as the casing in which the goods were handled in the commerce in question.

Packaging Machine.—In manufacturing, a machine for bundling yarns or goods into compact shape for transportation. Called also *bundling press*.

Packed Bit.—A flat bit for finishing a bored hole to exact size, packed up to the correct diameter with semi-cylindrical pieces of hardwood, converting it into a sort of broach or reamer.

Packer.—1. Any machine used for packing commodities; as, a flour packer.

2. A device as an expansible bag, to fill the space between the tubing and sides of an oil or gas well.

Packet.—To make up into a packet or bundle.

Packfong.—A Chinese alloy, containing about forty parts of copper, twenty-five of zinc, and thirty-two of nickel; also called *white copper*.

Packing.—1. Any material used to pack, fill up, or make close; as, the substance around the piston of a pump or other tube, to render it water or air tight.

2. An arrangement for keeping tight the stuffing boxes of steam cylinders, valve chests, etc., through which rods and spindles have to work; it consists of many kinds of textile fabrics, such as hemp, cotton, india rubber, canvas, and asbestos.

3. The cotton waste, used to fill journal boxes, which saturates with oil and holds it against the bearing.

4. A term colloquially applied to the thin sheets of material used for jointing flanges, etc.

Packing Case.—All except the largest and roughest metal and timber work is enclosed in packing cases, which are made in different manners to suit the articles transported. If made of strips they are called *crates*.

Packing Chisel.—A steel caulking tool used to force spun yarn or caulk lead into the bell and spigot joints of cast iron piping; also known as *yarning tool*.

Packing Hooks.—Hooked implements resembling packing screws, and used

in connection with them for pulling out small pieces of packing which cannot be seized by means of the screws.

Packing Piece.—Make up pieces of wood or iron, used to wedge up objects on the bed or face plate of a machine tool; chocking pieces serving as supports under anything; a general term for anything used as a wedge, filler, or chock.

Packing Ring.—A ring fitted around a piston to make it steam tight. For locomotives and other high speed engines, the Ramsbottom type of ring is usually employed, a narrow ring of steel or bronze, turned about one per cent. larger than the bore of the cylinder, the excess metal sawn out at the joint, and the rings sprung over the piston into suitable grooves around it. For slow and heavy engines, either one or two broad cast iron rings are employed, these necessitating the use of a junk ring or follower, together with tongue pieces to cover the joint; such large rings require a spring arrangement to hold them against the cylinder walls, very many excellent devices being used to that end.

Packing Screws.—Implements resembling long powerful corkscrews, with an eye forged in the shank for the hand or a toggle, by means of which old packing may be withdrawn from a stuffing box.

Pack Load.—The load of a pack animal; the quantity of a single burden for a mule or horse.

Pack Wall.—In mining, where a wall has been built of rubbish to support the roof beside the roads, more especially in working on the long wall system.

Pad.—1. A number of sheets of paper gummed together usually on two edges, to be stripped off as they are used.

2. A bundle, bale or pack.

3. Any cushion like part or thing filled with elastic material, serving to protect from or relieve jarring, pressure or friction.

4. In calico printing, to impregnate the cloth with a mordant.

Padding.—1. The act or process of making a pad or of inserting stuffing.

2. The material with which anything is padded.

3. In calico printing, the uniform impregnation of cloth with a mordant.

Paddle.—An implement with a broad blade which is used without a fixed fulcrum in propelling and steering canoes and boats.

Paddle Box.—The casing over the paddle wheels of a steamer.

Paddle Shaft.—In a side wheel steamer, the shaft upon which the paddle wheel is mounted; usually separate from the crank shaft and connected thereto by an elastic or flexible coupling.

Paddle Wheel Float.—In hydraulics, one of the boards or paddles attached to the radial arms of a water wheel. They are classified as follows: a, fixed floats; b, feathering floats, c, sliding floats; d, crank floats; e, frame floats; f, collapsing floats, and g, sculling floats.

Paddle Wheels.—In a steamboat, wheels provided with floats or vanes, situated at the sides or stern, which, by rotation, propel the ship.

Padlock.—A small portable lock, with a bow which is intended to pass through a staple so as to confine a hasp.

Paging.—The marking or numbering of the pages of a book.

Pail.—An open vessel of wood, tin, or other material, used for carrying liquids.

Paint.—A thick liquid which is used to give substances a superficial coating. It is made of a dry coloring material mixed with a liquid vehicle. It is used largely to give decorative color effects to structures; also, to preserve them from the action of the atmosphere and other corroding agencies. The dry coloring material of which the paint is made, is called a pigment. Mixed paints are paints prepared by the manufacturer, in the form of a paste which needs the addition of oil before it can be applied by a brush. Paints are made of various materials, such as, zinc, lead, lampblack, copper, and many forms of dry earthy materials, particularly the iron ore known as red hematite.

Paint Burner.—A hand brazier or spirit lamp for burning off old paint.

Painter.—1. A rope or line attached to the bow of a small boat, wherewith to make it fast.

2. One who follows the occupation of painting.

Painting.—The art or process of covering surfaces, for decoration or protection, with pigments or coloring substances mixed with a liquid medium.

Paint Shop.—That department of a factory, etc., in which its products are painted to protect their surfaces from decay, and to give a pleasing appearance.

Paint Spraying Machine.—One by which paint is thrown by the force of air through a nozzle upon a surface, instead of being applied by hand.

Palace Car.—In railway service, a term applied to such special railway cars as sleeping and drawing room cars.

Pale.—A pointed stake or slat either driven into the ground, or fastened to a rail at the top and bottom, for fencing or enclosing; a picket.

Pale Oils.—In lubrication, oils which have been subjected to filtration and purification to free them from their dark natural color.

Palette.—A thin board; a breastplate for a breast drill.

Palladium.—A rare metal associated with platinum; it is both ductile and malleable, and would be a very useful metal if the supply were larger.

Pallet.—1. A click or pawl used to convert a reciprocating into a rotary motion, as the pallets acting upon the teeth of an escape wheel of a clock.

2. In bookbinding, a tool used for lettering or gilding the backs of books.

Palm.—A measure of length, equaling 3 inches.

Palm Oil.—A fatty substance obtained from the fruit of the Guinea-palm of Western Africa. In cooler countries it becomes of the consistency of butter and of a reddish yellow color. Used in soap and candle making, and in lubricating compounds.

Palm Stay.—A boiler stay for flat surfaces in combustion chambers, fireboxes, etc.; it has one end flattened out like a hand and riveted to the plate, while the other is fastened either by a nut or by riveting.

Pan.—1. In manufacturing, a vessel either open or closed for boiling and evaporating; also, a natural or artificial depression in the earth for evaporating brine, in salt making.

2. In carpentry, the socket of a hinge.

3. In mining, a shallow dish on which samples of mineral are washed with water, a circular agitating motion being maintained by the hand to separate precious metals or ores from the waste.

Pane.—In quarrying, a flat dressed face of a stone block. Most commonly a plate of window glass, filling one opening in a sash.

Panel.—1. In mining, a section of coal between pillars of unusual width, also a flat dressed face of a stone.

2. In carpentry, a board having its edges inserted in the groove of a surrounding frame; also, a portion of a surface, usually of thinner material than the remainder, and surrounded by a frame or moulded border, as the *panel* of a door.

3. The space between the upright pieces of a built up girder.

4. Each space or cell into which a truss or bridge may be divided.

Panel Working.—A method of working a mine or colliery, by dividing it into large rooms separated by masses of coal, often over forty yards wide, the panel being one hundred yards on a side.

Panhead Rivet.—The ordinary form of rivet-head as manufactured, shaped as the frustum of a cone.

Pantile.—In roofing, a tile curved to an *ogee* shape, so that the prominent edge of one is covered by the dependent edge of the next. The usual size is $14\frac{1}{2} \times 10$ inches and they are laid with a 10 inch gauge; 170 tiles cover 1 square; i. e., $10 \times 10 = 100$ square feet.

Pantograph.—An instrument for copying maps, plans, etc., on an enlarged or reduced scale. It consists of four rods, jointed in pairs so as to form lazy tongs, provided with a fixed point, a tracer and a drawing point. The arms are set to any desired adjustment by means of thumb screws set in certain holes in the two pairs; the fixed point is set in the board or table on which the drawing and the paper are fixed; the tracer is passed over the original, and the drawing point describes the copy.

Pantry.—In carpentry, an apartment or closet in which bread and other provisions are kept.

Pap.—In a foundry, a short pin or stud making a projection on a casting which has to be turned and without which it could not conveniently be chucked. It is therefore a chucking or *centering piece* simply, and being such is cut off after its purpose is fulfilled.

Paper.—A thin tissue used as a medium for writing, etc., formed by the deposition on wire cloth of vegetable fibers while in a state of pulp, or a soft uniform mass suspended in water. The process of making paper is as follows: Pulp, as prepared from

rags, esparto, or wood, in *breaking* and *beating* engines, is fed from the *agitator* through *strainers* on to an endless *wire cloth*. This travels horizontally some fifteen feet upon a series of *tube rolls*, being further guided by a *breast roll* and *leading rolls*. Much of the suspended water falls through the wire cloth into the *sawedell*, whence it is returned to the *mixer*. The dandy roll prints the *watermark* and *couch rolls* press the half dry paper into *web* and transfer it to the *wet felt*, which passes it through *press rolls* to *dryers*, or heated drying cylinders around which the web is dried. The gloss is next imparted to the paper by the *calenders*, after which it is wound upon a reel or cut into sheets of the desired size.

Paper Clamp.—An appliance for holding newspapers or periodicals firmly together in position for convenient reference.

Paper Cutter.—In the paper trades, a machine for dividing the web into suitably sized sheets, or to trim a rough sheet to its correct size. There are two types, one of which operates upon a pile of single or folded sheets, and is frequently termed a *guillotine*; the second subdivides the webs into narrower portions by means of *slitters*, and cuts the strips to length either by a *stop cutter*, in which the feed rolls are stopped while the shears act, or by *continuous cutters*, in which a rotating blade, is brought into action at the proper moment by suitable gearing.

Paper Hanger.—One whose business is paper hanging.

Paper Joint.—In pattern making, a joint used in circular work, such as gear wheels which are built up in segments on a face chuck. The first course of segments is glued not directly to the plate, but to an intermediate thickness of paper, the paper being laid underneath the meeting of the end joints. This when set dry and hard is sufficient to retain the segments in place during turning, but when the work is done the entire ring is readily lifted from the plate without splitting the wood, the paper dividing and tearing through the center of its substance.

Papermaking.—The art of making a material in thin sheets from a pulp of wood, ground rags or other fiber, to be used for writing, printing, drawing, or for wrapping.

Paper Mill.—A manufactory in which paper is made.

Paper Scale.—In drawing, a scale made of a slip of thick paper, used by draughtsmen. Each slip has one edge marked out, and that with a single scale and fully divided. These are preferred by some draughtsmen on account of its flexibility and easy handling.

Paper Stock.—Rags or other material for making paper.

Paper Weights.—Flat paper weights are used in drawing offices for holding drawings open.

Papier Mâché.—A material made of paper pulp which can be moulded in any desired form, becoming when dried nearly as hard as wood. Writing desks, boxes, anatomical models, boats and even car wheels have been made from it. In the shape of fancy articles it is often lacquered and ornamented.

Papin, Denis.—Born 1647, died 1714. A French inventor. At first a physician, he soon devoted himself to experiments in physical science which resulted in several useful inventions, among which were the double air pump, an air gun and (1681), the famous "digester" for subjecting bodies to the action of high pressure steam and water at high temperature. But his chief distinction was the invention of a steam engine employing a piston (1698). He also invented the safety valve, discovered the principle of the siphon, and in 1690 built a boat propelled by a paddle wheel operated by the action of a pumping engine upon a water wheel. His many writings were valuable contributions to physics and mechanics, though they failed to get recognition during the author's lifetime.

Papyrus.—An Egyptian rush or water plant, from which paper derives its name. The central pith of the stalk was divided into strips and laid in rows on a flat surface, another layer being laid transversely on the first: the whole was wetted and pressed together, forming when dry, a sheet suitable for writing upon.

Par.—Equal to the standard, having the face value; a standard, either natural or agreed upon, with which to compare variations.

Parabola.—A plain curve, such that the distance of every point in it from a fixed point called the focus is equal to the distance of the same point from a fixed line called the directrix and generated from a plane cutting a cone parallel to its side.

Parabolic Reflector.—In locomotives, a reflector whose cross section is the curve known as the parabola, projecting an intense straight beam of light.

Parachute.—1. A large umbrella shaped apparatus for retarding the descent of a body through the air: used chiefly by aeronauts in descending from balloons.

2. A safety cage, used in mines, fitted with apparatus to hold it should the rope break.

Paradox.—A statement which seems at first thought absurd, but which on investigation is found to be well supported.

Paraffin.—A wax of fatty neutral substance, obtained from crude petroleum, which is used to make candles and for waterproofing paper or wood: it is also a local term for kerosene or petroleum.

Parallel.—A line, which throughout its whole extent, is equally distant from another line.

Parallel Cutter.—A milling cutter, whose outline corresponds to a serrated cylinder, without grooves, fillets, etc.

Parallel File.—In machinist work, a file in which there is no taper lengthways.

Parallel Flow.—In civil engineering, a stream running in a straight line due south or east; having a like course.

Parallel Forces.—In mechanics, forces which act in directions parallel with each other.

Parallel Lines.—Lines which have the same direction; hence parallel lines can never meet, however far they may be produced; for two lines taking the same direction cannot approach or recede from each other.

Parallel Motion.—A mechanism of pivoted links whereby one point is constrained to move in a straight path. The parallel motion is applied to the cross-heads of beam engines, replacing the customary guides, and performing the same service.

Parallelogram.—A figure whose opposite sides are parallel; the square and oblong are parallelograms; so also are other four sided figures, whose angles are not right angles.

Parallelogram of Forces.—In physics, a parallelogram, the *diagonal* of which represents the resultant of two velocities, forces, accelerations, etc., both in quantity and direction, when they are represented in quantity and direction by the two adjacent sides of the parallelogram.

Parallel Rods.—In a locomotive, the coupling or side rods used to connect one pair of driving wheels with another.

Parallel Ruler.—An instrument for drawing parallel lines, so constructed as to have its successive positions parallel to each other; or consisting of two movable parts, the opposite edges of which are always parallel.

Parallel Vise.—A bench vise in which the movable jaw is attached to a slide which draws in and out of the body, thus maintaining the two jaws in a parallel line with each other. This pattern is commonly used for light work and has many advantages in dealing with finished pieces.

Parameter.—1. In conic sections, a chord through the focus perpendicular to the transverse axis.

2. In mathematics, a line or quantity serving to determine one point, line, figure or quantity out of a class of such things.

Parapet.—A low wall or masonry fence; the breast high protection on a bridge or high structure.

Parboil.—To boil in part; to cook partially by boiling; spoken of serious burns or scalds.

Parbuckle.—In rigging, a kind of purchase for hoisting or lowering a cylindrical burden; as, a cask. The middle of a long rope is made fast aloft and both parts are looped around the object, which rests in the loops, and rolls in them as the ends are hauled up or *payed out*.

Parceled.—Covered with canvas, cloth or tarred rope, to prevent wear or rust.

Parch.—To burn the surface of; to scorch; to dry to extremity; hence *parchment*, which is the dried skin of sheep.

Parchment.—Originally the skin of sheep and goats prepared for use as a writing material. Vellum is a kind of fine parchment made from the skin of kids, calves, etc. Modern parchment is ordinarily only a thick, tough quality of paper, specially treated.

Parenthesis.—1. One of the upright curves, or the pair, used by writers to denote a sentence or clause inserted within a sentence grammatically complete without it.

2. That part of a sentence which is enclosed within the recognized signs ().

Parget.—Plaster, especially that made of lime, sand and hair, used for lining chimneys; intended to give a smooth surface and help the draught.

Pargeting.—Plastering, especially ornamental stucco or plaster work in relief, used in either internal or external decoration.

Paring Chisel.—The ordinary hand chisel of the carpenter or joiner, being used by the hand alone, while the firmer chisel is struck with the mallet. The chief difference lies in the longer handle of the paring chisel, which is also usually made with a blade 8 inches from bolster to point.

Paring Machine.—A name sometimes applied to the slotting machine, when it is employed to shape the exterior surfaces of machinery parts; as, in cutting around the fork end of a connecting rod.

Paring Tools.—In tools, all tools which act by splitting, or which remove the fibers in a direction approximately parallel with their cutting faces. Chisels, gouges, planes, axes, and tools for metal turning and planing, generally, may be classed as *paring tools*. Pattern makers' long chisels and gouges are specifically called paring tools, to distinguish them from the short or *firmer* tools.

Paris Green.—In chemistry, a poisonous green powder, consisting of a mixture of several double salts of the acetate and arsenite of copper. It has found very extensive use as a pigment for wall paper, artificial flowers, etc.

Parlor Car.—In railways, a car especially designed and furnished for the comfort of passengers.

Parquet Flooring.—In architecture, an ornamental flooring consisting of an inlay of geometric or similar patterns, generally of different colors and made of hard wood.

Parral.—In navigation, the hoop or collar of greased rope by which a yard is shackled to the mast at the slings; the parral slipping on the mast as the yard is raised. Iron rings are now commonly used.

Parry.—To ward off; to stop or turn aside; as, a blow, or argument.

Part.—One of the portions, equal or unequal, into which anything is divided; something less than a whole; a number, quantity, mass, or the like, regarded as going to make up, with others, a large number, quantity, mass, etc.; a piece; a fragment.

Particle.—A minute part or portion of matter; a very small substance; an atom; a jot; as, a particle of sand, of lime, or of light.

Parting Sand.—In moulding, any sand used to prevent the faces of the two halves of the mould from adhering together. Generally the burnt sand cleaned from the castings.

Parting Tool.—A straight narrow turning tool used to cut or part off work in the lathe centers.

Partinium.—An alloy of aluminum and other metals used in motor car construction, for such pieces as cast gear cases and crank cases.

Partition.—In architecture, a dividing wall; a barrier which divides a building into rooms or apartments.

Partner.—One who has a part of anything with another; an associate, a sharer.

Partnership.—An alliance or association of persons for the prosecution of an undertaking, or, a business on joint account; a firm.

Party Wall.—A wall between two houses which is common to both buildings, or one built across a single building to divide it into separate dwellings.

Pass.—1. A narrow passage or entrance, especially in a mountain range, a depression through which a road may be made or a path opened and communication be established between one slope of the range and the other.

2. An order of admittance to public gatherings.

3. A permit, duly signed to travel free on railroads or surface lines.

Passage.—1. A way or course through which a person or thing may pass.

2. Fare, ferriage or toll paid for being carried between two points; as, passage money,

Pass Book.—A book in which a trader enters articles bought on credit and then *passes* or sends it to the customer; also said of books upon which savings bank deposits are entered.

Passenger Car.—In railway engineering, a car exclusively employed in passenger traffic; they are well lighted and in the winter are heated. Also called *passenger coach*.

Paste.—A kind of cement made of flour and water, starch and water, and the like; used for uniting paper, or other substances; as, in bookbinding, etc.; also used in calico printing, as a vehicle for mordant or color.

Pasteboard.—A stiff, thick kind of paper board, formed of several single sheets pasted one upon another, or of paper pulp pressed into moulds, etc.

Pasting.—In a foundry, securing together the halves or sections of cores previously rammed in separate portions, with clay water, or with flour paste.

Patch.—A small piece of material used to repair anything; as, a piece of metal to strengthen a weak place; if it be bolted or studded, it is called a *soft patch*; if riveted, a *hard patch*.

Patch Piece.—In boiler making, a plate of wrought iron or steel and sometimes of cast iron, riveted or bolted to broken parts for purposes of repair. Broken castings are sometimes patched in this way in preference to replacing them with new. Boiler plates are often *patched*, and so is plated work generally, which has been injured by corrosion or accident.

Patch Screw.—A screw or bolt with a coned or countersunk head, used to attach patches to boilers, etc. The screw is put in by means of a wrench gripping a square projecting part beyond the chamfer, the square being chipped or broken off as soon as the patch is tight.

Patent, or Letters Patent.—A special privilege secured by law, usually applied to the exclusive privilege to manufacture and sell a certain article.

Patent Agent.—An attorney who makes a speciality of patent law, especially the drawing up of claims and the filing of applications for letters patent.

Patent Fuel.—In steam engineering, a term often applied to fuel not coming under the common class of coal or wood, as briquettes, etc.

Path.—A narrow footway beaten by the feet of men or animals, as distinguished from a wider roadway made especially for the accommodation of traffic.

Pattern.—1. A copy; anything given to be reproduced.

2. A copy or replica of an article made in wood, iron or other metal, upon which a mould is formed in wax, plaster or sand. The cavity corresponding to the pattern being subsequently filled with fluid molten metal, which, on cooling, retains the shape of the original pattern.

3. A flat piece of paper, fabric or sheet metal, reproducing the developed outline of a curved form; as, of a garment or of a vessel of any description. The flat material is cut out to the outline of the pattern, and then curved to its proper form.

Pattern Box.—A device in a loom, for presenting several shuttles to the *picker* in the proper succession for forming the figure in weaving.

Pattern Card.—A card on which are attached several samples of weaving, embroideries, etc.

Pattern Chain.—In weaving, a device for working the shuttle box, so that each shuttle bearing different colored threads may be brought to the *picker* in turn.

Pattern Letter.—In founding, a letter of wood or metal, cemented on to a pattern.

Pattern Maker.—A wood worker who makes patterns, from which pieces are moulded and cast in iron, brass, etc.

Pattern Makers' Lathe.—A light lathe, usually of the bench pattern, used by pattern makers in reproducing cylindrical forms.

Pattern Making.—The art of making patterns for moulding. These are usually made from seasoned pine, except where there is much repetition work, when the wooden pattern is made with a double shrinkage, and iron duplicates cast therefrom, these latter being used as patterns in the foundry.

Pattern Register.—A book in which a record is kept of all patterns, and their places in the drawing office, to which the date of their construction and the

job for which they were made, together with other useful memoranda, may be added.

Pattern Shop.—The department of an engineering works, in which wooden patterns are made, from which castings are subsequently to be moulded.

Pavement.—1. A hard, solid surface covering, for a floor, road or pathway, usually resting immediately on the ground; as, the pavement of a street.

2. In mining, the seam of fireclay which usually underlies each seam of coal in England.

Pavement Pipe.—A pipe or tube rising to the surface from a gas or water main, giving access to a valve, or protection to a small pipe.

Paving.—Pavement; a floor of stones or brick; the laying of a paving.

Paving Brick.—In civil engineering, a hard burned, partially vitrified brick, or moulded and burned blocks of tempered clay. They are also called *clinker* brick, from the sharp, glassy sound they produce when struck.

Pawl.—A hinged or pivoted piece, having an edge or hook made to engage with ratchet teeth, as for driving a ratchet wheel, or for preventing reverse motion; a click or ratchet.

Pay.—1. To satisfy or content; as, to satisfy (another person) for service rendered, property delivered, etc.

2. To cover, as the bottom of a vessel, a seam, or a spar with tar or pitch, or a waterproof composition of tallow, resin, etc.; to smear.

Pay Dirt.—A placer mining term for sands or gravel that contain gold or silver in such quantity as pays for getting it.

Payed or Paid.—Painted, tarred, greased to resist moisture, or wear and tear; pitched after caulking with oakum.

Paymaster.—One who pays; an officer or agent of a corporation or an employer, whose duty it is to pay salaries, wages, etc., and keep account of the same.

Pay Roll.—A list of the employees of an undertaking, having the time and rate of salary against each name and the total to be paid.

Payt.—Abbreviation for payment; also written pay't.

Peak.—A point; the sharp end or top of anything that terminates in a point.

Peak Tank.—A tank for fresh water or ballast in the wedge shaped peaks or extremities of the ship.

Peal.—A loud sound or succession of loud sounds, as of bells.

Pearl Ash.—The salt which is obtained from the ashes of plants by washing and evaporation, or if refined, it is the *potassium carbonate* of commerce.

Pearlite.—In mining engineering, a glassy, volcanic rock of grayish color and pearly luster.

Pear Tree Wood.—Wood of the pear tree, growing in temperate climates. The wood is used for making instruments; as, set squares, curves, and occasionally for pattern making. A cubic foot weighs 45 pounds.

Peat.—A substance of vegetable origin, consisting of roots and fibers in various stages of decomposition, and found, as a kind of turf or bog, in low situations, where it is always more or less saturated with water. Peat next to the surface is less advanced in decomposition, is light, spongy and fibrous, of a yellow or light reddish brown color; lower down it is more compact, of a darker brown color, and in the lowest strata it is of a blackish brown, or almost a black color, of a pitchy or unctuous feel. Peat in its natural condition generally contains from 75 to 80 per cent. of water. It sometimes amounts to 85 or 90 per cent., in which case the peat is of the consistency of mire.

Pebble Powder.—Blasting gunpowder made into somewhat large lumps, to afford a larger amount of surface for ignition.

Pebbling Machine.—A machine for giving leather on the grain side, an imitation of a more costly leather, by pressing a pattern into it, as imitation morocco and seal is made from cowhide. This machine is also a *polishing, glassing or graining machine*, made so by a simple change of the rollers.

Peck.—1. A measure; one fourth part of a bushel; a dry measure of eight quarts.
2. To strike; pick; thrust against or dig into with a pointed instrument.

Pecking.—In civil engineering, bricks from the outside of the kiln insufficiently burned. Also called *sandel brick* or *semel brick*.

Pedal.—A lever or machine part actuated by the foot; as, the pedals of a bicycle by which it is driven; the *pedals* of a motor car which actuate various brakes, etc.

Pedal Pin.—The bolt or pin in the crank arm of a bicycle, which secures the pedal and upon which the latter revolves.

Peddle.—To sell from place to place; to retail by carrying around from customer to customer; as, to peddle small wares of any kind.

Pedestal.—1. In architecture, the base or foot of a column, statue, vase, lamp or the like; the part on which an upright work stands. It consists of three parts: the *base*, the *die* or *dado* and the *cornice* or surbase moulding.

2. In railway engineering, a casting secured to the frame of a truck of a railroad car, and forming a jaw for holding a journal box.

3. In machinery, a *pillow block*; a low housing.

4. In civil engineering, an iron socket or support for the foot of a brace at the end of a truss of a bridge, where it rests on a pier.

Pedestal Binder.—In railway engineering, a cast, wrought iron, or cast steel bar or filling piece, fitted across the opening between the pedestal legs, and held in place by bolts passing through the bottom rail or brace of the frame. Called also, *pedestal cap* and *pedestal brace*.

Pedestal Bolts.—In railway engineering, bolts holding a pedestal cap or binder in place, on either the main frame or the truck frame.

Pedestal Coil.—In steam heating, a group of connected straight pipes arranged side by side, and one above another; used as a *radiator*.

Pedestal Sheave.—A guide pulley for a rope transmission device, in which a sheave works on a universal joint, the whole being secured to a pedestal on the floor, thus serving as a fair lead for haulage, etc.

Pediment.—In architecture, a triangular structure at the termination of a roof, or over a portico, window, or doorway.

Pedometer.—An instrument resembling a watch, used for recording the number

of steps taken, and thus enabling one to approximate the distance traveled.

Pedomotor.—A device for the mechanical application of one's foot for motive power; as, the treadle of a sewing machine or a bicycle.

Peek.—A shop term, meaning to look slyly or pryingly; to look through a crevice.

Peel.—1. To loosen the skin or rind.

2. The skin or bark of anything.

3. A kind of wooden shovel used by bakers in putting bread into, or taking it out of, an oven.

4. In printing, a wooden pole with a short cross piece at the end, to carry printed sheets to and from the horizontal poles on which they are dried. Used by paper makers for the carrying of sheets of loft dried paper.

Peg.—A wooden nail or pin; also a similar article made of metal. They are made in many sizes for a great number of uses, as in *shoemaking*, for securing the upper and counter to the sole; as turn pins upon which the wires of *musical instruments* are coiled and stretched; in *surveying*, etc., for marking out boundary lines, or lines traversed by the surveying party; in securing *tents* to the ground, etc.; in *furniture*, as a projection whereon to hang clothes or domestic utensils; in *carpentry*, as a dowel for fastening boards together.

Pegger.—In shoemaking, a machine for pegging the uppers to the soles; a shoe pegging machine.

Pelt.—The skin of a beast with the hair on; an undressed hide; a skin preserved with the hairy or woolly covering on it.

Pelton Wheel.—An impulse water wheel, belonging to the class of wheels known as *hurdy gurdies*, suitable for working under extreme heads of water. The wheel is of small diameter, revolving on a horizontal shaft, the water being supplied through a nozzle in a needle like jet. The great feature of the Pelton wheel is the bucket which is divided midway by a tapered ridge, which prevents the accumulation of any "dead water," the stream splitting on the ridge and curving right round to right and left in each half bucket, thus providing the maximum force of reaction.

Pen.—An instrument for writing with a fluid ink, usually of metal, and fitted to a holder; by extension both pen and holder united are so called.

Pencil.—1. A small brush, made of fine hair or bristles, used by painters for laying on colors.

2. An instrument formed of black lead, colored chalk, or the like, and pointed at the end, or enclosed in a case and pointed, used for writing and drawing.

Pencil Compasses.—A pair of drawing compasses, one leg of which is furnished with a tube for holding a lead or small pencil.

Pendant.—1. Something which hangs or depends; a hanging appendage.

2. A long, narrow piece of bunting, worn at the mastheads of vessels. In this sense usually spelled pennant.

Pendent.—Hanging from; suspended; having no support except from the upper part or apex.

Pen Drawing.—One made by the use of a writing pen.

Pendulum.—A body so suspended from a fixed point as to swing freely to and fro by the alternate action of gravity and momentum; as, the pendulum of a clock. A clock pendulum in which the effect of changes of temperature on the length of the rod is so counteracted, usually by the opposite expansion of different metals, that the distance of the center of oscillation from the center of suspension remains invariable; as, the mercurial compensation pendulum, in which the expansion of the rod is compensated by the opposite expansion of mercury in a jar constituting the bob; the gridiron pendulum, in which compensation is effected by the opposite expansion of sets of rods of different metals.

Pendulum Motion.—In mechanics, the movement of a body so suspended from a fixed point as to swing freely to and fro by the alternate action of gravity and momentum.

Pendulum Rod.—The actuating rod for the pendulum motion of stern wheel steamers.

Pene.—The pointed end of a hammer head, sometimes shaped as a blunt wedge, but more frequently as a ball or knob.

Penetrate.—To enter into; to make way into the interior of, especially against difficulties or opposition; to effect an entrance into; to pierce.

Pening.—The act or process of hammering sheet metals with the pene of a hammer, either to straighten them or to impart a desired curvature.

Peninsula.—In geography, a portion of land nearly surrounded by water, and connected with the larger body of land by a narrow neck or isthmus.

Pen Knife.—A small pocket knife; formerly a knife used for making and mending quill pens.

Pennant.—In a vessel, a triangular flag; a long, narrow flag flown on a vessel when in commission.

Penny Nail.—The term penny, when used to mark the size of nails, is supposed to be a corruption of pound. Thus, a four penny nail was such that one thousand of them weighed four pounds, ten penny such that one thousand of them weighed ten pounds, etc.

Pennyweight.—A troy weight containing twenty four grains, or the twentieth part of an ounce.

Pension.—A periodical allowance to an individual or to those who represent him, on account of past services; an official document granting to the holder a pension for past services, or some meritorious work done by him.

Penstock.—In hydraulics, the flume, conduit, or trough leading from the source of supply to a turbine or water wheel.

Pentagon.—A polygon bounded by five sides.

Pent House.—A shed or roof sloping from the main wall or building, as over a door or window; a lean to.

Perceive.—To obtain knowledge through the senses; to receive impressions by means of the bodily organs.

Per Cent.—A contraction of *per centum*, signifying the proportion in or to one hundred. Thus, interest or discount at a rate of five per cent. means that five units have to be paid or deducted upon every one hundred; a *ten per cent. grade* denotes that a road rises or falls ten feet vertically in each hundred feet horizontally.

Percentage.—The rate of proportion to one hundred; as, a percentage of 2.6 carbon in pig iron would signify that, out of every hundred parts of iron, two and six tenths would be carbon.

Perception.—The act of perceiving; cognizance by the senses or intellect; apprehension by the bodily organs.

Perch.—1. In surveying, a measure of length containing five and a half yards; a square rod or pole, the 160th part of an acre.

2. In civil engineering, in solid measure or measuring stonework, a mass 16½ feet long, 1 foot in height and 1½ feet in breadth, or 24½ cubic feet.

Perchloride.—In chemistry, a chloride having a high proportion of chlorine.

Percolation.—The act or process of filtering; filtration; straining; as, the process of exhausting the virtues of a powdered drug by letting a liquid filter slowly through it.

Percussion.—Impact or collision of moving bodies; the effect caused by blows; the quality of being operated by blows.

Percussion Cap.—A small cap or cup of copper, containing fulminating powder and used with a percussion lock to explode gunpowder, or used with an electric battery connection to explode dynamite for rock blasting.

Percussion Frame.—In mining, a concentrating machine, consisting of a table suspended by four chains at its corners, and which is bumped continuously against wooden buffers, settling the heavy ore, which is shoveled or run off according to the construction of the machine.

Percussion Fuse.—In civil engineering, a tube or casing filled with combustible matter by means of which a charge of powder is ignited; as, in blasting. Called also *fusee*.

Perforated.—That in which holes have been bored or pierced.

Perforated Metal.—Sheet metal which has been pierced with holes, usually by a power press.

Perforated Pulley.—In millwrighting, a wrought iron or steel pulley, which is honeycombed with numerous small holes perforated through the plate of which it is composed, and through which the air can escape, thus giving a belt closer adhesion.

Perforation.—1. The act of perforating, or of boring or piercing through.

2. A hole made by boring or piercing; an aperture.

Perform.—To carry through; to bring to completion; to execute; to do.

Performance.—Execution or completion of anything; accomplishment.

Perigee.—In navigation, that point in the orbit of the moon which is nearest

to the earth; opposed to *apogee*. It is sometimes, but rarely, used of the nearest points of other orbits, as of a comet, a planet; called also *epigeum*.

Perihelion.—In navigation, that point of the orbit of a planet or comet which is nearest to the sun; opposed to *aphelion*. Also called *perihelium*.

Perimeter.—The outer boundary of a body or figure, or the sum of all the sides. In circular figures, instead of perimeter, we use the terms circumference or periphery.

Perimeter of a Polygon.—Its boundary considered as a whole.

Period.—In mathematics, one of several similar sets of figures or terms, marked by points or commas, placed regularly after a certain number, as in numeration, and in the extraction of roots.

Periodical.—In a periodic manner; at regular intervals.

Periodicity.—The quality or property of recurring at regular intervals of time; repetition of circumstances, processes, etc., at periodic intervals.

Periphery.—The circumference of a circle, ellipse, etc.

Periscope.—An optical apparatus for obtaining a horizontal view through a vertical tube, by means of an arrangement of lenses and mirrors; this contrivance is used in submarine boats to obtain a lookout while running a short distance below the surface.

Permanent.—Continuing or intended to continue in the same place or state; durable; opposed to temporary; as, a permanent building.

Permanent Gas.—A substance that is gaseous under common conditions of temperature and pressure; as, oxygen, hydrogen, nitrogen, etc., formerly regarded as permanent, but known, since 1877, to be liquefiable.

Permanent Load.—A load which a structure is designed to bear continually, as opposed to one which may be imposed and removed at intervals. Thus, in a railway station or a bridge, the weight of the station will be the permanent load borne by the girders and piers; the trains, as they pass, giving a temporary load.

Permanent Set.—1. When a metallic piece is stressed beyond its elastic limit, deformation occurs, the piece being either stretched, crushed, bent or twisted, according to the nature of the strain. This alteration in form is known as *permanent set*.

2. Alteration or deformation of a structure or piece under a load, the force applied being such that the piece deformed does not resume its original shape or position when the load is removed.

Permanent Way.—In railways, a term denoting the superstructure, its rails, ties and ballasting.

Permeability.—The capacity of being easily penetrated; as, sandy strata by water.

Permeate.—To pass through the pores or interstices; to penetrate and pass through without causing rupture or displacement; applied especially to fluids which pass through substances of loose texture; as water permeates a filtering stone, or as light permeates glass.

Permit.—Written permission or authorization to do something; as, a permit to inspect a steam plant, or some method of manufacture.

Permutation.—In mathematics, the arrangement of any definite number of objects, units, letters, etc., in all possible orders, usually taken together two by two, three by three, etc. It differs from *combination*, in that the order is always considered, hence the number of permutations is always greater than the number of combinations.

Peroxide.—In chemistry, an oxide containing more oxygen than any other oxide of the same series.

Peroxide of Hydrogen.—Hydrogen dioxide, also known as *oxygenated water* on account of the facility with which it decomposes into oxygen and water. It is a syrupy liquid, usually sold as a 10 to 20 per cent. solution in water; it is colorless and odorless, with an astringent taste; is a powerful bleaching agent by virtue of its rapid oxidation of coloring matters, a *disinfectant* and *deodorizer*.

Perpend.—In masonry, a header extending through a wall so that one end appears on each side of it; bonder; bond-stone; through stone or through binder.

Perpendicular.—Straight up and down; vertical; being at right angles to the plane of the horizon.

Perpetual Motion.—A mechanical motion that once started will continue until the parts are worn out; impossible only because of the existence of friction.

Persian Wheel.—In hydraulics, an improvement on the *noria*. The *noria*, properly speaking, has fixed buckets or jars, while the Persian wheel has them pivoted, so that the delivery is effected at a greater height and with less waste of power.

Person.—A human being spoken of indefinitely; one; a man; as, any *person* present.

Perspective.—In drawing, the art of depicting objects as they appear to the eye, representing solids or surfaces not lying in the plane of delineation in a drawing on a flat surface, or conveying the impression of depth and distance by correct drawing and judicious tones of colors and shadows. Perspective may be said to have two branches, *Linear*, which deals alone with forms and magnitudes, and *Aerial*, which expresses space, suggesting distance in a picture by the medium of "atmosphere," giving the sense of the thickness of layers of air lying between the observer and a distant object.

Pestle.—An implement for pounding, breaking or braying substances in a mortar.

Pet Cock.—An air cock used to relieve pipes that are airbound; a small faucet in a water pipe or pump, to let out air, or at the end of a steam cylinder to drain it.

Petrol.—A trade name for a variety of light petroleum distillates (gasolines or benzines) blended to give a specific gravity of about .700 to .720; volatility and homogeneity of boiling points being the desired features for reliability. This constitutes the usual fuel for motor cars, etc.

Petroleum.—Rock oil; a liquid, inflammable, bituminous substance exuding from the earth or collected on the surface of the water in wells and fountains in various parts of the world, or oozing from cavities in rocks; it is essentially composed of carbon and hydrogen.

Petroleum Furnace.—One in which a spray of petroleum is used as fuel.

Petroleum Motor.—An oil engine, propelled by the explosion of vapor generated from ordinary illuminating petroleum or kerosene.

Petticoat Pipe.—1. In a locomotive, the coned diaphragm inside a diamond stack acting as a spark arrester.

2. The cone, over the blast nozzle, inside the smokebox, which conducts the waste gases to the stack.

Pewter.—An alloy usually consisting of tin and lead; a hard, tough, but easily fusible, composition originally consisting of tin with a little lead, but afterwards modified by the addition of copper, antimony or bismuth. Inferior sorts contain a large proportion of lead.

Phanerite Series.—In geology, the uppermost part of the earth's crust, consisting of deposits produced by causes in present and obvious operation.

Phenol.—Otherwise known as *carbolic acid*, commercially obtained from that portion of coal tar distilling between 180° and 190°. It is a colorless crystalline body in the pure state but soon assumes a pink color; it is soluble in water, alcohol or ether, and liquefies upon the addition of ten per cent. of water to the crystals. Carbolic acid possesses a characteristic odor and taste resembling creosote, is a powerful antiseptic and germicide, and a corrosive and irritant poison.

Phenomenon.—1. Something visible which is of a remarkable or unusual nature, beyond the common order of things.

2. That which is visible or apprehended by human observation; something as it appears, not necessarily as it really is.

3. An observed result or appearance; any visible accompaniment of a physical or chemical process; as, the *phenomena* of heat, light, etc.

Phial.—A glass vessel or bottle; a broad, flat, shallow cup or bowl; also spelled *vial*.

Philology.—The study of language, especially in a philosophical manner and as a science; a treatise on the science of languages.

Phonograph.—In physics, an instrument for the mechanical registration and reproduction of audible sounds, as articulate speech, etc. It consists of a rotating cylinder or disk covered with some material easily indented, as tin foil, wax, paraffin, etc., above which is a thin plate carrying a *stylus*. As the plate vibrates under the influence of a sound, the stylus makes minute indentations or undulations in the soft material, and these, when the cylinder or disk is again turned, set the plate in vibration and reproduce the sound.

Phonoscope.—An instrument for observing or exhibiting the motions or properties of sounding bodies.

Phosphor Bronze.—A bronze or gun-metal made from tin and copper to which phosphorus has been previously added, the percentage of phosphorus being from two to nine. The alloy is very hard and durable, is suitable for heavily loaded bearings and parts subjected to shocks. Owing to its not emitting

sparks, it is used to make chisels, scrapers and other tools for use in powder mills. It is a good electrical conductor, and as its strength is superior to pure copper, it is much employed for telephone wires, etc.

Phosphorescence.—The state or property of becoming luminous without combustion. Either due to slow oxidation attended with light as in phosphorus, or by the molecular vibrations causing the emission of light after the source of light has been removed.

Phosphor Tin.—Tin with which phosphorus has been combined, rendering it suitable for making phosphor bronze.

Phosphorus.—An elementary substance, of a yellowish color, and semi-transparent, resembling fine wax. It burns in common air with great rapidity, and in oxygen gas with the greatest vehemence. Even at the common temperature, it combines with oxygen, undergoing a slow combustion, and emitting a luminous vapor.

Phosphuretted Hydrogen.—In chemistry, a colorless gas, analogous to ammonia, and having a disagreeable odor resembling that of garlic. Called also *phosphine*.

Photo Engraving.—1. A name applied to each of many processes, in which the action of light on a sensitized surface is made to change the nature or condition of the substance of the plate or its coating, so that it may by processes be made to afford a printing surface corresponding to the original from which the photographic image is derived.

2. The photographic process is also used for obtaining a picture upon a plate or block for subsequent engraving. The value of the process consists in the quickness and the fidelity of the picture. In some cases it is a substitute for an offset or tracing process, in other cases it affords a means of obtaining a picture from nature or from a model.

Photography.—1. The science which relates to the action of light on sensitive bodies in the production of pictures, the fixation of images and the like.

2. The art or process of producing pictures by this action of light.

Photogravure.—A photo engraving; also the process by which such a picture is produced.

Photo Lithography.—The art or process of producing a lithographic picture or copy from a stone, by the aid of photography.

Photometer.—An instrument for measuring the illuminating power of gas,

electricity, oil, etc. Deficiency of light and all impurities are shown by the instrument.

Physic.—In metallurgy, small amounts of various substances added to bar iron, used for the manufacture of steel, in order to assist in the elimination therefrom of sulphur, phosphorus and other deleterious ingredients. Generally speaking, any substance added to a metal or alloy, to improve it. Burnt steel is sometimes *physicked*.

Physical.—Of or pertaining to material nature, relating to what is material and perceived by the senses, opposed to what is mental or moral.

Physical Examination.—An examination of the bodily condition of a person.

Physical Tests.—Experiments conducted with specimens of materials, to determine their inherent properties, as tenacity, elasticity, etc., by the aid of mechanical combinations of levers and weights, to apply the stresses in the desired manner.

Physics.—That branch of science which treats of the laws and properties of matter and the forces acting upon it; that department of science, formerly known as *Natural Philosophy*, which treats of the causes which modify the general properties of bodies. It differs from *chemistry*, which treats of the changes in the nature of the body.

Piano Wire.—Also known as *music wire*; a remarkably fine and strong steel wire, intended for use in musical instruments, but much employed in the mechanical arts for measuring purposes, making small spiral springs, for brick and soap cutting, etc. It is measured by a gauge whose numbers run in an ascending scale for increase of diameter: No. 2 being 0.0108", No. 15, 0.085", and No. 30, 0.078", respectively.

Piazza.—An arcaded and roofed gallery; a portico; a term popularly applied to a veranda.

Pick.—1. An iron tool tapering to a point from a heavy mass or head, in which is inserted, transversely, a wooden handle; sometimes pointed at both ends, and having the handle inserted at the middle. It is used for loosening and breaking up hard earth, ground, stones, etc. Various kinds are employed by quarrymen, miners, etc.

2. In weaving, the same as shot; one pass of the shuttle.

Pickaxe.—In mining and excavating, a heavy iron tool, curved and sometimes pointed at both ends, wielded by means of a wooden handle inserted in the middle; used by excavators, miners, quarrymen, etc.

Pick Blade Governor.—A type of hit or miss governor applied to gas or other explosion engines, in which a narrow blade is interposed between the cam driven gearing and the gas valve spindle. This pick blade is connected by rods to the governor sleeve, so that increase of speed pulls the blade away from its counterpart, on the gas valve spindle, severing the connection between the latter and the cam shaft. In some engines graduated steps or notches are made on the pick blade or spindle blade, so that the governor gives varying charges within specified limits, and a miss charge when the speed passes the limit.

Picker.—1. A machine for opening, cleaning and mixing cotton or wool; as, a mixing picker, cotton picker.

2. A sharp pointed steel rod used in lifting wooden patterns from the sand after they have been rammed therein.

3. In paper making, a machine for tearing rags to pieces, in which a wooden cone, studded with spikes, revolves within a casing also furnished with spikes.

Pickerstaff.—In weaving, a jointed lever worked by the power loom, so that its upper or free end, which is usually shod with rawhide, strikes the shuttle and shoots it to and fro in the loom.

Picking.—1. In excavation, the act of breaking up the soil; as, with a pick.

2. In excavation, that which is loosened from the solid soil.

3. In brickmaking, the *overburned* bricks.

4. In mining, rough sorting of ore.

Picking Peg.—The piece in a weaving loom which strikes the end of the shuttle and impels it through the *warp*.

Picking Table.—A table on which the process of picking cloth is done. The cloth is subjected to a strong light and all blemishes removed from its surface by *tweezers*.

Pickle.—To steep in an acid bath, for the purpose of removing impurities; as, in the following:

1. In boiler-making, the plates are steeped on edge for a period of six hours, in racks within a wooden bath, containing a 5% solution of *hydrochloric acid* in fresh water. This loosens the mill scale, which is removed by the aid of wire brooms, mechanical brushes and a plentiful supply of water. The cleaned plates are

immersed in an alkaline bath of weak quicklime and water, to neutralize remaining acid, and finally washed in fresh water.

2. In iron founding, the castings are placed on racks, and have a 25% solution of *sulphuric acid* poured over them, by means of a ladle, the acid being collected and used over again. After standing to drip all night, the castings are washed down with a hose and brooms, remaining sand being removed by wire brushes and old files. A better method is to steep for two or three hours in a wooden vat containing ten per cent. solution of *hydrofluoric acid*, which attacks scale and sand, but not iron. A vat may be used three or four times with the same acid.

3. In drop forging, *hydrofluoric acid* should be used as for castings, the forgings being subsequently washed with brushes and fresh water; if this acid splashes on the hands, they should be washed at once in *aqua ammonia*.

4. In brass founding, the castings are immersed in a 15 to 20% solution of *nitric acid*, then thoroughly washed with clean water; this removes sand and impurities, leaving the castings bright and shining, minimizing the labor of polishing.

Picotah.—In hydraulics, a well sweep employed in Hindostan. The boom or sweep is pivoted on a forked piece of wood near the well, the lower end of the boom being weighted while a leathern bucket depends from its upper end. The operator walks up and down the boom, his weight causing the bucket to dip into the well, or to arise therefrom, a second person emptying the water as it is drawn.

Picrate.—In chemistry, a salt of picric acid, having an exceedingly bitter taste.

Picric.—Of, pertaining to, or having an exceedingly bitter taste.

Picric Acid.—A chemical obtained variously, as by the action of nitric acid on phenol. It is used in dyeing and is an ingredient in certain explosives.

Picture Plane.—In drawing, a square of glass, usually framed like a picture with a base, so that it can stand upright. In instruction in perspective drawing, this is placed between the eye of the student and the subject to be drawn, the drawing being sometimes made directly upon it.

Piece.—A fragment or part of anything separated from the whole in any manner; as, by cutting, splitting, breaking, or tearing; a part; portion.

Piece Number.—A number given to a pattern or a part of a machine to be used in case of repairs or duplication.

Piece Work.—A system of payment by results, in which the workman is given a set price for each article or process.

Pier.—1. An upright projecting portion of a wall; a buttress or the like.

2. A mole or jetty, or a projecting wharf; a plain detached piece of masonry, especially when serving as a support to some structure; as, the pier of an arch, a bridge pier.

Pierce.—1. To bore or drive a hole through; to penetrate or make an opening.

2. To work sheet metals, etc., into ornamental patterns by perforating with holes.

Piercer.—In moulding, a wire used in making vent holes.

Piermaster.—An official in charge of a pier used as a wharf, who superintends the berthing, discharging and lading of shipping.

Piezometer.—An instrument for measuring the pressure of a fluid or liquid; a pressure gauge.

Pig Boiling.—In iron making, the process of so called wet puddling, in which the pig is melted under protection of a layer of slag or cinder, decarburization being effected by the oxides in the fettling and the scale.

Pigeon Hole.—In a steam boiler, a small hole below the bridge wall, enabling the combustion chamber to be raked out under steam; it is closed when not in use by a cast iron slide.

Pig Iron.—Iron refined from the ore in a blast furnace, and run into gridiron shaped moulds in the open air, where it takes the form of semi-cylindrical bars, attached at right angles to a longitudinal bar, thus bearing a resemblance to a sow and pigs.

Pig Iron Breaker.—In smelting, a machine used for breaking up pig iron into short lengths for remelting in the cupola; some machines will break a ton in a minute. In the absence of a machine, pig is broken either with a sledge hammer, or by throwing the bars down upon the angular edge of a mass of iron embedded in or laid upon the ground.

Pig Lead.—Lead in 300 pound bars or moulds as it comes from the reduction furnace; the commercial form in which it is sold.

Pigment.—A preparation used by painters, etc., to impart colors to bodies; any dry earthy substance that, mixed with a liquid vehicle, forms *paint*.

Pig Mould.—In smelting, the receptacle for the refined iron which is tapped out of the refinery. It consists of cast iron blocks, rebated and luted together with fire-clay, and in communication with the refinery through a plate. It rests upon a cistern of brickwork or cast iron, through which a current of cold water circulates, in order to cool the mould. A *rib* is often left in the bottom of the mould, to produce a line of weakness in the plate, to facilitate its breaking up.

Pilaster.—In architecture, a rectangular pillar or column set within a wall and seldom projecting from it more than one fourth of its breadth.

Pile.—1. A mass or quantity of anything gathered or thrown together in one place, so that its parts lie one upon another, either regularly or irregularly; a heap; as, a pile of lumber.

2. A heavy timber forced into the earth to form the foundation for a building, a wharf or the like; a *spile*.

3. Hair collectively, hence, the fiber of wool, cotton, and the like; hence, also, the nap; the fine hairy substance of the surface of cloth, carpeting, velvet, etc.

Pile Cap.—A beam lying across the tops or heads of a row of driven piles, secured to each, thus binding the whole together for mutual strengthening.

Pile Coating.—In civil engineering, a covering of burlap cloth, which has previously been saturated with a mixture of asphalt, tar or other similar ingredients. It is used for covering piles which are to be driven in places where the *teredo worms* are very destructive.

Pile Driver.—An engine for driving down piles, consisting usually of a high frame with a suitable apparatus for raising to a height, by animal or steam power, a heavy mass of iron, which is dropped upon the pile.

Pile Hammer.—The monkey, tup or ram used in driving piles.

Pile Hoop.—An iron band put around the head of a timber pile to prevent splitting.

Pile Screw.—A screw used for the bottoms of cast iron piles. The screw, usually of one revolution only, and cast on a center tapered core or cylinder, is run into the soil by worm gearing from above, and becomes the attachment for the upper columns or piles.

Pile Wire.—The wire around which the warp threads are looped to make a pile fabric in weaving. When the *pile* is to be cut, like velvet or plush, a groove on the top of the wire acts as a director for the knife.

Piling.—1. A method, similar to *fagoting*, adopted with iron plates and forgings. Plates, as rolled, are cut into square pieces, and stacked upon one another, the grain alternating in each layer. These stacks or piles are heated, welded into a solid mass and beaten down by the hammer, then rerolled into plates once more. With large wrought iron forgings, it is customary to weld the mass up piece by piece, by adding fresh iron or cut scrap.

2. In civil engineering, etc., the driving of piles to form foundations, piers, wharves, and other works.

3. In leather manufacture, the putting of hides in a pile or heap to sweat them and loosen the hair.

Pillar.—The general term for a firm, upright support for a superstructure; a pier, column or post.

Pillar File.—In tool making, a narrow, thin, flat handled file with one safe edge.

Pillar Shaper.—A design of shaping machine, in which all the driving mechanism, whether geared or crank, is concealed within the box or *pillar framing* of the machine itself.

Pillar Working.—In coal mining, the usual method of getting the coal, by driving roads at right angles to each other through the seam, and continuing the excavation in this manner, leaving square pillars of coal to support the roof, on the removal of which the roof falls in forming the goaf. This system of working is also known as *post and stall*, *pillar and breast*, *pillar and stall*.

Pillow Block.—A box or frame enclosing and supporting a brass journal or bearing in which a shaft revolves. It generally consists of two pieces, the box or block holding the brass, and the cap. This fitting is also known as *journal box*, *plummer block*, etc.

Pilot.—1. One licensed by law to conduct vessels in and out of port by directing the helmsman, or designating the courses to be steered.

2. A strong framing of wood or iron fixed in the front end of locomotives, in certain countries, to push obstructions off the track, notably, strayed cattle; it is wedge shaped, with a horizontal member or shelf a few inches above the rails, and extending a little distance either side of them; known also as a *cowcatcher*.

Pilot Burner.—A small jet or flame used as a pilot light for incandescent mantle burners; or a small burner attached to large atomizers for liquid fuel burners, to secure immediate ignition. By the use of this flame, the atomizer, especially where the more volatile fuels are employed, is kept at a proper temperature, and everything is in readiness for starting the fires at full power from the banked condition, as with fire floats, fire engines, etc.

Pilot Cloth.—A coarse, stout kind of cloth, for overcoats.

Pilot Engine.—A locomotive; an assisting engine; the leading engine of a double header; a detached locomotive traveling at a stated interval ahead of a special train.

Pilot House.—On a steam vessel, a house or shelter on the bridge to protect the captain and quartermaster.

Pilot Light.—A small flame kept burning when large lamps, mantle burners, etc., are extinguished, so that the main burners may be lit when necessary, merely by turning on the gas. This precaution saves the delicate incandescent mantles from damage by the slight explosion caused by igniting the flame with a match or taper.

Pilot Valve.—A small valve fitted to larger valves on a main steam pipe, used to equalize pressures before opening or closing, or to free the piping of pressure if necessary. Also called *by-pass valve*.

Pin.—1. A short, stiff piece of wire, with a sharp point and a round usually flattened head.

2. A peg or bar of metal or wood used for a fastening or support; as, the bolt of a door.

3. The part of a tenon or dovetail that fits into the mortise, a *pin* serving to stop a hole and fasten the two pieces together.

Pin Block.—In vise work, a wooden block used to steady small pins when filed in the vise.

Pincers.—An instrument having two handles and two opposing curved jaws, working upon a pivot, thus belonging to the same category of grasping implements, as *tongs*, *pliers*, and the like. Pincers are used by woodworkers for the purpose of withdrawing nails, etc., from wood.

Pinch.—A close compression, as with the ends of the fingers, or with an instrument; a nip.

Pin Chain.—A term applied for the sake of distinction to those linked chains, as used in elevators, conveyers, etc., whose links are detachable, and secured to each other by removable *joint pins*.

Pinch Bar.—In railway service, a special crowbar with one end flattened and bent to form the fulcrum and point of a lever; used to move a locomotive or cars for valve setting, etc., by successive applications between the tread of the wheel and the rail.

Pinbeck.—An alloy of copper and zinc resembling gold; a yellow metal composed of about three ounces of zinc to a pound of copper. It is much used in the manufacture of cheap jewelry.

Pinched.—In mining, narrowing or thinning, as in a vein.

Pin Drill.—A drill with a central pin or projection to follow a smaller hole for making a larger hole, sinking a recess for the head of a bolt and the like.

Pine.—A member of the pine family of trees, with evergreen, needle shaped leaves, distributed widely and plentifully through the Northern Hemisphere. The name is also given to many of the woods obtained from these trees, others being known as *fir* and *deal*. The timber is resinous, many species yielding valuable tar and turpentine; some varieties furnish long straight grained logs, suitable for spars; the wood generally is soft, straight grained and easily worked.

Pinery.—A pine forest; a grove of pine trees.

Pinion.—A small cog wheel in gear with a larger one, either singly or in a train, a small gear wheel meshing with a rack.

Pink.—1. In navigation, a ship with a very narrow stern, used in the Mediterranean.

2. Anything supremely excellent; the embodiment of perfection of something.

3. A color resulting from the combination of a pure vivid red, with more or less white; so called from the common color of the flower of that name.

Pinnace.—In navigation, a small vessel propelled by oars or sails and used on men-of-war as a tender, or for a coast watch.

Pin Spanner.—A type of spanner or key used to turn cylindrical nuts, the spanner being curved to fit the nut and having a projecting stud which fits into holes disposed around the circumference of the latter. This

type of nut is frequently employed in adjusting collars on lathe mandrels and similar parts, and is the opposite to a hose coupling, in which an eye on the curved spanner fits over a projecting snug or nob on the nut itself.

Pint.—A term of measurement where one pint of pure water equals one pound; a liquid measure where two pints equal one quart or one eighth of a gallon.

Pintle.—1. In mechanics, a pin upon which anything pivots.

2. In navigation, one of the metal braces or hooks upon which a rudder swings.

3. In carpentry, the pin of a hinge for a door; a dowel or something equivalent to it.

4. In wagon building, the *king pin* of a wagon.

Pin Tongs.—In blacksmithing, pliers that may be held closed by a sliding ring; also called *sliding tongs*.

Pintsch Gas.—An illuminating gas derived from petroleum, which is sprayed into red hot retorts or chambers and is thus converted into a fixed gas. The gas is cooled, purified, and compressed into cylinders, for use in lighting railway trains, gas buoys and the like.

Pin Vise.—A small hand vise, with a serrated V in each jaw to grip pieces of wire, holding them when being ground or filed to a taper form, for fastening small work together.

Pipage.—Transportation, as of petroleum oil, by means of a pipe line or conduit; also, the charge for such transportation.

Pipe.—A long conducting passage, usually a line of tubes; any long tube or hollow body; especially, such a one as is used as a conductor of water or other fluids, as a drain pipe, water pipe, etc.

Pipe Bending Machine.—An apparatus whereby iron, copper or brass pipes may be bent or coiled to any desired curvature or pitch, being fed through an arrangement of grooved rollers, the pitch and feed being easily adjustable. Such machines leave a smooth external and internal surface, without bruises.

Pipe Clamp.—A metallic strap or band, made to fit around a pipe, gripping it closely, for the purpose of stopping leaks, etc., a piece of jointing material being usually compressed between the clamp and the pipe.

Pipe Clay.—A clay containing much silica, and but small percentages of iron or lime. On clarifying, it becomes a beautiful white color, which it does not lose on baking.

Pipe Couplings.—Sleeves or sockets of cylindrical form with female threads, which receive the ends of two adjacent pipe lengths.

Pipe Cutter.—An instrument for severing wrought iron pipes, consisting of a bent lever, partially encircling the pipe, on which one or more cutting discs are mounted, the pressure and feed of the cutting discs being regulated by a screw as the lever is rotated around the pipe.

Pipe Die.—In pipe fitting, a tool for cutting threads on pipes.

Pipe Fittings.—Connections, appliances, and adjuncts designed to be used in connection with iron pipes, such as *elbows* and *bends* to alter the direction of a pipe; *tees* and *crosses* to connect a branch with a main; *plugs* to close an end; *bushings*, *diminishers* or *reducing sockets* to couple two pipes of different dimensions, etc.

Pipe Grip.—In steam and pipe fitting, an implement consisting of an iron bar with a curved end and provided with a chain of square links to hook on to the jaws of the curved end.

Pipe Hanger.—A device similar in appearance to a shafting hanger or bracket, provided with clamps for supporting piping.

Pipe Head.—The same as *exhaust head*: a sort of cowl fitted to the upper extremity of exhaust pipes to prevent emission of fine sprays of water or oil, which may do damage to surrounding property.

Pipe Line.—A method of transporting petroleum by pumping it through pipes. Stations are placed about 25 to 30 miles apart, depending upon conditions, each pump being sufficiently powerful, to deliver to the second station in case of breakdown, etc. Two receiving tanks are provided at each station, being used alternately for the reception of oil, from the preceding pump, or as suction for pumping to the next, by this means of working two tanks, as in engine tests, it is possible to obtain an account of the quantity of oil run from one station to another.

Pipe Nails.—In a foundry, broad flat-headed nails of wrought or malleable iron used as chaplets in light cored

work. Being employed largely for cast iron water pipes, they are thus named.

Pipe Roller.—In construction work, these are made of different lengths of iron pipes to suit the work, and used as rollers for moving heavy articles and machinery. Generally they are filled with sand and the ends plugged up, or they may be filled with a solid piece of wood.

Pipe Stocks.—Holders for dies by means of which threads are cut on pipes by hand.

Pipe Threads.—Screw threads employed in connection with wrought iron pipe. The standard thread is the V, with an angle of 60° between its sides, slightly rounded at top and bottom, and having a taper.

Pipe Tongs.—In pipe and steam fitting, a hand tool for gripping pieces or lengths of pipes.

Pipette.—A small tube with an enlarged body, used to withdraw liquids from one vessel to another. It differs in shape, and some are graduated to measure the quantity transferred. The "dropper" for a fountain pen is one sort of pipette; the usual pattern being dipped in the liquid until full, when the operator closes the top of the tube with his finger, the pressure of the atmosphere on the lower opening retaining the liquid in the pipette as it is moved from one vessel to another.

Pipe Vein.—In mining, a vein which contracts and expands, instead of preserving its uniform size. The expansions are called *bunches*.

Pipe Vise.—A gripping appliance for holding pipes while being threaded or cut, having two V shaped serrated jaws sliding within one another, the grip being applied or released by means of a screw and toggle.

Piping.—1. In manufacturing, a small cord covered with cloth.

2. In mechanics, a musical device to produce a sound like that of a bird.

3. In plumbing, steam and gas fitting, the whole system of pipes in a factory, mill or house; the act of laying a pipe system.

4. In harness making, a leather covering to a trace chain.

Pipkin.—A small earthenware vessel with a straight or looped handle, such as is used by painters to hold colors, etc.

Pippin File.—A fine file used by die sinkers, etc., whose cross section resembles a pippin, or rather a small pear.

Pirn.—1. In manufacturing, a quill or reed on which thread or yarn is wound; a *bobbin*.

2. The wound yarn on a weavers' shuttle.

3. The reel of a fishing rod.

Pisé.—In civil engineering, a wall made of stiff earth or dry clay rammed in between moulds which are carried up as the wall rises. Called also *pisé work*.

Pistol.—Many devices are so named from a resemblance to a pistol, in use or in appearance, especially with regard to the stock or handle; as, a carpenters' *pistol router*, or the *pistol pipe tuiere* in a hot blast furnace.

Piston.—In mechanics, a device for receiving the pressure of, or operating upon, a fluid in a cylinder or tube. It usually consists of a short cylinder, fitting within a cylindrical vessel, along which it moves back and forth. It is used in *steam engines* to receive motion from the steam, and in *pumps* to transmit motion to a fluid. It is the essential part of a reciprocating engine; a metal disc working in the cylinder, under the pressure of steam, and connected by means of a linkage of rods with the cranked rotating shaft, whereby the power is usefully applied. In *locomotives*, the piston is either solid, with Ramsbottom or snap rings fitted into grooves in its circumference, or else is built up with metallic packing rings, retained in place by a plate or ring. In such cases, the body of the piston is termed the *head*, any solid ring used to separate the split packing rings is the *bull ring*, while the retaining plate or ring is known as the follower.

Piston Air Drill.—A pneumatic drilling machine, in which the compressed air acts upon a piston or pistons of a small reciprocating engine, instead of blowing upon the vanes of a fan or propeller in a rotary engine.

Piston Air Valve.—The valve which controls the air supply of an internal combustion engine, when of the piston form.

Piston Clearance.—The distance between the piston and the cylinder covers at either end of the stroke, ranging usually from $\frac{1}{4}$ " to $\frac{1}{2}$ ". Generally known as *clearance* without qualification. Usually expressed as a percentage of the stroke.

Piston Follower.—A term applied to the junk ring of a piston, which retains in place, the packing, whether metallic, leather or rope.

Piston Head.—A term occasionally employed to denote the body or main part of a piston, distinguishing it from its packing rings, etc.

Piston Key.—In mechanical engineering, a flat wedge shaped key passing through the center of a piston and the end of a piston rod, to fasten them together.

Piston Ring.—In mechanical engineering, a Ramsbottom, or snap ring, fitting into a groove in the circumference of the piston to prevent leakage of steam.

Piston Rod.—In a steam engine, a rod or bar of wrought iron or steel, working through a stuffing box in the cylinder end or cover; it is fastened to the center of the piston at one end, and transmits the power exerted upon the latter by the steam or other working fluid.

Piston Rod Gland.—A flanged ring of brass or cast iron, which is used to hold the piston rod packing in its stuffing box.

Piston Rod Nut.—Used to secure the piston on its rod. The latter is tapered to fit the conical seat in the piston, and the reduced diameter beyond the taper is threaded for the nut which locks the two together.

Piston Rod Stuffing Box.—A prolongation of the cylinder end or cover, bored out cylindrically for the reception of packing, this being retained in place by the gland, through which the piston rod works. The use of the stuffing box is to maintain a steam or air tight joint around the rod.

Piston Speed.—An engineering expression, signifying the total distance traversed by the piston of an engine, in one minute, rather than the actual velocity, at any given instant of time. Thus, an engine whose cranks have 24 inches throw, revolving 63 times per minute, is said to have a piston speed of 504 feet per minute, or $24 \times 2 \times \frac{\pi}{12} \times 63$.

Piston Spring.—A spring within a piston face, pressing the packing tight against the cylinder.

Piston Valve.—A development of the long D slide valve, invented in the eighteenth century by William Murdock. Instead of a D section, the valve is made cylindrical. The parts are continued around the whole of the circumference, having the appearance of lozenge shaped or triangular openings in a ring or bushing, through which the valve works. The valve is actuated by valve gearing

and distributes the steam exactly in the same manner as the ordinary valve. It has the advantage of being balanced with respect to the steam.

Pit.—1. To mark with dents, pits or hollows; to form hollows in.

2. A natural or artificial hole in the ground, especially when wide and deep.

3. A coal mine shaft.

4. An excavation in the earthen floor of a foundry to receive molten metal.

5. A vat, as for use in tanning.

Pitch.—1. The distance from center to center of any two adjacent teeth of gearing, measured on the pitch line.

2. The distance measured on a line parallel to the axis, between two adjacent threads or convolutions of a screw.

3. The distance between the centers of holes, as of rivet holes in boiler plates.

Pitcher Nose.—A cock or tap having a bent down lip.

Pitchfork.—A fork used in loading and unloading carts and wagons.

Pitching.—1. The process of knocking off rough lumps from a block of building stone.

2. The process of coating the insides of tanks and other vessels with pitch or similar material to render them water tight.

3. A face of rubble stone laid upon a bank as a protection against the wash of water; a lining or sheath of masonry. *Pitched work* is not thrown indiscriminately nor laid regularly as *coursed rubble*, but pitched into place with a certain amount of regularity which binds the stones one with another, making a face suitable for piers, breakwaters and the like.

Pitching Tool.—A broad stone dressing tool with a beveled edge, like that of a caulking tool instead of the cutting point of a chisel; used for pitching or dressing off rough lumps of stone.

Pitch Line.—1. The line or circle upon which the pitch of teeth is measured.

2. In a rack, the line along which the teeth are measured, corresponding to the pitch circle of a wheel or pinion.

3. In riveting, the line along which the pitch of the rivets is measured. In a treble riveted joint, it would be the outer line of rivets, along which the pitch is the greatest, the joint being so designed as to make possible rupture take place on that line.

Pitch of Gear Wheels.—The distance between tooth centers, measured on the pitch line, or the number of teeth per unit of diameter, as in a gear wheel.

Pitch of a Propeller.—The distance it would advance in a solid substance in one complete turn, like the turn of a screw.

Pitch of a Roof.—The inclination or slope of the sides; usually expressed by the height in parts of the span; as, a quarter pitch, one fifth pitch, whole pitch, etc.; sometimes by the length of the rafters in parts of the span; as, two thirds pitch, three quarters pitch, etc.; or in degrees; as, a pitch of 45°; equilateral pitch or gothic pitch.

Pitch of a Saw.—The slope of the face of the teeth.

Pitch of a Screw.—The distance apart of two consecutive coils, measured from center to center for one revolution. A screw in one revolution will move a distance equal to its pitch.

Pitch of Wheels.—The pitch of the teeth of wheels is the distance apart from center to center of the teeth, measured on the pitch circle. In all calculations for speed of toothed gears, the estimates are based upon the pitch line, the latter standing in the same place as the circumference of a pulley.

Pitchometer.—An instrument by which the pitch of the propeller of a steam vessel is measured while in place.

Pitch Pine.—One of the several species of pine, abounding in resinous matter and yielding pitch.

Pit Frame.—In mining engineering, the frame work around and over the shaft of a coal mine.

Pith.—The soft spongy substance in the center of the stems of many plants and trees; it consists of cellular tissue.

Pithead Gear.—The winding pulleys and their supports, placed over the shaft of a pit.

Pit Lathe.—A large lathe, whose faceplate revolves in a race trough or pit excavated in the floor of the machine shop, thus being capable of taking in large pulleys, fly wheels, propellers, etc.

Pitman.—1. One who works in a pit, as in sawing, coal mining, etc.; especially in mining, the man who has charge of the underground machinery.

2. In machinery, a rod that connects a rotary with a reciprocating part, one end being attached to a crank and the other to a wrist pin; a connecting rod; as, in a steam engine.

Pitman Box.—A metal strap, with its included brasses, or bearings, at the end of a pitman and surrounding a crank pin; a rod end.

Pitman Head.—The enlarged end of a pitman, where it is coupled with the part of the machine that drives it or the part that it drives.

Pitot Tube.—In hydraulics, a bent tube used to determine the velocity of running water, by placing the curved end under water, and observing the height to which the fluid rises in the tube; a kind of current meter.

Pit Prop.—In mining, a timber used to support the roof of a mine.

Pit Saw.—A variety of two handled saw, used for cutting logs over the mouth of a pit, one man standing in the pit.

Pitter.—A contrivance for removing the pits from peaches, plums and other stone fruit.

Pitting.—In a steam boiler, a form of corrosion resulting in rows of minute holes or pits like pock marks. Pitting is most capricious in the location of its attack; it may be described as a series of holes often running into each other in lines and patches, eaten into the surface of the iron to a depth sometimes of one quarter of an inch. Pitting is a dangerous form of corrosion, and the dangers are increased when its existence is hidden beneath a coating of scale.

Pit Work.—1. In mining, that work which is done in a pit or shaft.

2. In civil engineering, the shaft work of a tunnel or any other excavating; as in a square deep excavation of small dimensions.

Pivot.—A pin or short axis fixed only at one end, and on which a wheel or other body turns; the end of a shaft or arbor which rests and turns in a support; as, the pivot of a watch.

Pivot Bridge.—A form of drawbridge in which one span, called the *pivot span*, turns about a central vertical axis.

Place.—1. A particular point or portion of space; an occupied situation or building; a town or city.

2. To set in a particular place or spot.

Placer Mining.—Washing for free gold or silver in sands or gravel, generally along a stream, where the precious metals have been carried along with the detritus of the reef, by water.

Plain.—Without elevation or depression; even; level; flat; pertaining to a plane.

Plait.—A braid, as of straw; to fold; to double in narrow folds.

Plan.—A drawing of a building or machine, done in a manner resembling a map; that is, as viewed from above; a representation of a horizontal plane of anything; a diagram.

Plane.—1. A tool for smoothing boards or other surfaces of wood, forming mouldings, and the like, consisting of a stock, usually of wood, from the under side, face, or sole of which projects slightly, the steel cutting edge of the iron, or chisel, which inclines backward, and has an aperture in front for the escape of shavings.

2. In anthracite mining, a jig or self acting incline; an incline where coal is lowered by gravity.

3. In geometry, a surface which is such that, if any two points in it be joined by a straight line, the line will lie wholly on the surface.

4. A perfectly flat, smooth and level surface, without curvature, elevations or depressions.

Plane Blade.—In carpentry, the cutting iron inserted in a plane stock and fastened by a wedge. The form and size depend on the kind of plane and use of the same. Also called *plane iron*.

Plane Figure.—In geometry, a portion of a plane bounded by straight or curved lines, or by both combined.

Planer.—A shop term for a planing machine.

Planer Centers.—Devices similar to lathe headstocks and centers, used to support small work upon the table of a planing machine.

Planer Jack.—A small screw jack with a ball and socket tilting head, employed to set work upon the table of a planing machine. These jacks save time in leveling the work, and hold the job firmly, while accommodating themselves to rough and uneven surfaces.

Planes.—In carpentry, tools used for surfaces of wood. Classified according to size; as, jack, fore, smoothing, and jointer plane.

Plane Surfaces.—In carpentry and machinery, plane surfaces are produced by the planing machine, by the file, by the joiners' plane, and by grinding using an abrasant.

Planetary Gear.—A class of change speed gear for automobiles, etc., in

which several small wheels travel around the circumference of a larger one, with the teeth of which they are constantly in mesh.

Plane Trigonometry.—That part of mathematics which treats of the relations of the sides and angles of plane triangles.

Planet Wheel.—A wheel revolving around, or within the circumference of, another wheel, by which it is driven.

Planimeter.—An instrument used for measuring areas, as in indicator diagrams. It consists of a system of levers, furnished with two points, one of which is secured to the paper, while the other is traced around the outline of the figure; the circuit being completed, the area is read from a graduated dial. For a diagram, the area is divided by the length, which gives the average height or mean pressure.

Planimetry.—That branch of geometry which deals with the measurement of plane surfaces; the mensuration of areas, as distinct from *longimetry*, which deals with lengths of lines, or *stereometry*, which measures solid contents.

Planing Machine.—1. A machine tool for planing metals, etc.

2. A complex machine for planing wood, especially boards, consisting usually of a rapidly revolving cutter, which chips off the surface in minute shavings, as the piece to be planed is passed under it by a suitable feeding apparatus.

Planing Mill.—A workshop, usually of considerable size, fitted up with machinery, for planing or putting a smooth surface on boards and planks, by means of rapid revolving cylindrical cutters, as well as tenoning and matching lumber.

Planish.—To render smooth and level, as a metallic surface, by light blows with a smooth faced hammer.

Planishing Hammer.—One having highly polished and convex faces, rather broader than usual, and used for planishing or smoothing and brightening metals by light blows.

Plank.—A broad piece of sawed timber, differing from a board only in being thicker.

Planing Machine.—In hat making, a machine for rubbing, pressing and steaming hat bodies, to give them firmness and proper thickness.

Plank Sheer.—In boat building, a lengthwise strip covering and fastening the timber heads; a covering board or gunwale.

Planometer.—A *surface plate*. A metal plate, truly surfaced, used as a test in the production of other flat surfaces.

Plant.—The collection of machines and appliances, grouped together in any particular workshop, factory or building. An assemblage of machinery gathered together for one common end, or for the business of an individual, firm or corporation.

Plantation.—A place brought under cultivation, more especially in tropical and subtropical regions, where the more important crops are planted and tilled, the work being done by people resident on the estate. A place where sugar, rice, rubber, tea or coffee, etc., is grown; often employing much machinery; as, a sugar plantation.

Planter.—A machine constructed for putting seeds into the ground, each accompanied by a piece of fertilizer; a *planter* sets seed in a single row, as distinguished from a *drill* which plants numerous rows abreast of each other, and a *sower* which sows broadcast.

Plant Setter.—A miniature drill or planter, carried by hand, which saves the labor of digging the hole, by inserting the seed and manure, and covering it up.

Plash.—The movement or noise of water splashed about, a splash.

Plaster.—1. A composition made of varying proportions of lime, sand and water, together with hair or other binding material. Used as a coating for walls, ceilings and partitions, being usually laid on *laths* and *furrings*.

2. Gypsum or plaster of paris, as used for the ornamental or intricate parts of a plasterer's work.

Plaster Board.—In masonry, a large square sheet of a mixer, designed to be nailed on to studdings or walls and replacing the first and second coat work of plastering.

Plaster Chisel.—A wide, flat chisel used by plumbers, etc., for cutting plaster walls and ceilings.

Plasterer.—An artisan who plasters walls and ceilings, executing ornamental work, such as cornices, mouldings, etc., as well as the ordinary flat surfaces.

Plasterers' Hock.—An implement used by the plasterer to bring the mortar from the mortar board close to the wall, and in such a position as to enable him to *strike* it off with the trowel, direct on the wall.

Plastering Trowel.—A flat bladed implement with a cranked handle, used in spreading plaster on walls, ceilings, etc., The *gauging trowel*, for spreading lime, putty and general work, is pointed like a masons' trowel; the *margin trowel*, for angles, is square; the *plastering trowel* proper is a square trowel nearly a foot long.

Plaster Lath.—In building construction, strips of wood or metal to cover a brick, concrete, stone or timber wall, so as to give or make a surface for putting on the plaster. If made of wire or perforated steel plates, it should come under the name of *plaster lathing*.

Plaster of Paris.—Obtained by heating or calcining, at about 275° F., the *gypsum*, originally quarried near the French Capital. This rock is a calcium sulphate containing water of crystallization, which loses much of the water on heating, forming commercial *plaster of paris*. If this is mixed with water to make a paste, the latter soon sets solid, as the water and calcium sulphate combine to form gypsum once more.

Plastic.—Capable of being moulded to form; as, clay is rendered *plastic* by the addition of water to prepare it for the potter.

Plastic Clay.—A peculiar clay used in making pottery.

Plastic Metal.—In metals, a white alloy having a low coefficient of friction and anti-corrosive properties, which adapt it for high speed bearings and for use under water. It contracts very little in cooling and fuses at a low temperature, and is used for fan bearings, locomotive axle boxes, glands, and for coating propeller blades.

Plat.—1. A small piece of ground laid or marked out with some design or distinct use, usually a portion of flat, even ground.

2. In mining, an enlargement at the foot of a shaft, to afford accommodation for handling kibbles or tubs; similar to the piteye of coal mines.

Plate.—1. A piece of metal extended or flattened to an even surface with a uniform thickness.

2. A piece of timber which supports the ends of the rafters.

3. A sheet of glass or metal; the term conveys the idea of stoutness and rigidity of form, as distinguished from the customary use of sheet, which signifies thinness or something easily bent.

Plate Bending Rolls.—A machine for imparting the desired curvature to plates for ship building, tank or boiler making, etc. A cylindrical roll is superposed above two others between two housings, the upper roll being adjustable by a screw at either end, while one housing is pivoted so that it may be swung out when necessary to draw off a plate which has been bent to a complete cylinder. By passing the plate backwards and forwards through the rolls, tightening the upper one at each pass, the flat plate is gradually bent to the required curve.

Plate Coupling.—A flanged coupling, by means of which two lengths of shafting are secured to each other.

Plate Edge Planer.—A type of planing machine employed to true up the edges of plates, giving them the proper bevel for caulking or fullering if required, the process being necessary owing to the roughly sheared edges when the plate leaves the rolling mill. The plate is clamped on a long bed, along one side of which the tool rest travels, generally actuated by a leading screw, while the plate remains stationary.

Plate Frame.—A system of locomotive framing in which steel plates, one inch to one and one eighth inches thick, are riveted together with angles, etc.

Plate Girder.—A girder of which the web is formed of a single vertical plate, or of a single series of such plates joined together.

Plate Glass.—A superior kind of thick glass, made from calcium and sodium silicates, and used for mirrors, show cases, large window panes, etc. The pot containing the molten glass is taken from the furnace and its contents poured upon a planed cast iron table of large size, with turned up edges. A very heavy iron roller is run up and down the length of the table upon adjustable rails, which are set to obtain the desired thickness, and smooth the cast glass. The rough plate is immediately annealed in a special furnace, after which it is polished. The plate is bedded in plaster of Paris and worked over by a rubbing machine with cast iron shoes at the end of its arms, sand and water being first employed, and then emery. After smoothing both sides, different plates are rubbed upon each other and then finally polished with felt covered wooden blocks and the use of jeweler's rouge and water. The finished plates are finally cut to size with a diamond.

Plate Iron.—Rolled iron sheets over three eighths inch in thickness.

Plate Layers.—The English equivalent of trackmen; those whose duty is to lay and maintain in order the railway track or permanent way.

Plate Moulding.—In founding, more especially where a large quantity of similar small articles are to be made, the patterns of a sufficient number to fill one box or flask are disposed on a plate of a suitable size, the halves of each pattern being fixed on opposite sides of the plate, together with suitable pieces of semi-circular section to connect all together and form the runners. It is usual to make the patterns first in wood, with double contraction, and then to retain the iron pattern for subsequent use in the shop.

Platen.—A small table or plate; specifically the planed slab of metal which exerts pressure in a hand printing press. The sheet of paper is placed in the *tympan*, a frame padded within for the reception of the sheet, and folded over on the form of type. The whole is passed under the *platen*, upon which pressure is exerted by means of a screw or toggle joint, thus making the impression.

Plate Spring.—A laminated spring; one built up of tempered steel plates fastened together at the middle of the span by a buckle, and suspended from a hanger at either end, the weight being applied at the buckle. This type is generally employed for both railway vehicles and those in use on common roads.

Plate System.—In ice making, a method where the ice tank is divided by hollow plates, containing coils through which the brine circulates: the ice forms on each side of the plate, beautifully transparent, all included air and impurities having been frozen out.

Plate Train.—In a rolling mill, a train for dealing with steel or iron plates; owing to the weight of the pieces handled, a plate train is usually two high, and driven by reversing engines, the rolls being reversed at each pass in either direction.

Platway.—A device attempting to secure the advantages of railways of common roads with ordinary vehicles; flat, narrow plates are laid on the surface of the roadway, at a distance of 4 to 5 feet apart, and the wheels of ordinary carts run on them, enabling a horse to draw a heavier load than on macadam or asphalt.

Platform.—Any floor or flat surface raised above the surrounding or adjacent level.

1. A raised walk upon which passengers alight from railroad cars.

2. A landing stage used by river steamers and in docks to compensate for the rise and fall of the tides.

3. In architecture, the row of beams on which the roof covering rests.

Platform Crane.—A crane mounted on the platform of a truck.

Platform Scale.—A weighing machine with a flat scale or platform, upon which the object to be weighed is placed.

Platform Steps.—Stairs or steps at the corners of a railway or surface car to afford entrance or egress.

Plating.—1. The art or operation of fitting and placing in position the plates or outside skin of a steel vessel. After plating, they are secured by the *rivets*.

2. The art of coating stronger or baser metals with a film of a more valuable one, such as silver, gold, or nickel; either by electro deposition or otherwise.

Platinum.—In chemistry, a metallic element, intermediate in value between silver and gold, occurring native or alloyed with other metals. It is a heavy tin white metal which is ductile and malleable, but very infusible, and characterized by its resistance to strong chemical reagents. It is used for crucibles, for stills for sulphuric acid, and in form of foil and wire for many purposes.

Platonic Bodies.—In mathematics, the five regular geometrical solids: the regular tetrahedron, hexahedron, octahedron, dodecahedron, and the icosahedron.

Play.—A shop term for the amount of slack or looseness of fit between two pieces: the movement of one piece within another.

Pleat.—To double in narrow folds; fold into strips; make into pleats; to consolidate by felting. Same as *plait*.

Pledge.—To bind by a promise or declaration; to place in possession of another, as security, any guarantee for the performance of an act.

Plenum.—Any condition of fullness; a pressure of air, the opposite to vacuum. The *plenum method of ventilation* is a system for ventilating buildings by forcing in fresh air, the plenum or fullness created by its incoming, causing an outward flow of foul air.

Pliability.—The quality or state of being pliable; flexibility; as, pliability of movement.

Pliant.—Capable of plying or bending; easily bent; readily yielding to force or pressure without breaking; flexible; flexible; lithe; limber; as, a pliant thread.

Pliers.—Pinching tools, usually of small size and operated in one hand. They are used for manipulating wire or small objects, the nose or points being variously shaped for different purposes. The gripping points are more or less straight instead of being curved like *pincers*.

Plimsoll Mark.—The circle and line on a vessel's side denoting the *safe load water line*; named after Samuel Plimsoll, M. P., for Derby, England, who was instrumental in promoting the shipping legislation leading to a life saving reform.

Plinth.—In architecture, a square, projecting, vertically faced member forming the lowest division of the base of a column; in building, the plain projecting face at the bottom of a wall immediately above the ground.

Plod.—Among laborers, a term meaning to toil; to drudge; to tread with a heavy, laboring step.

Plot.—1. A small extent of ground.
2. To divide and stake out in lots, as land.

Plotting.—In drawing, the laying down of the lines of diagrams which are made with a view to the calculations of strains, etc., by the graphic method alone.

Plow.—In mechanics, a contractors' implement, which prepares the ground for cultivation by severing slices from the surface of the soil, and then turning them over, thus loosening the earth. Modifications of the plow are used to loosen the soil for various purposes.

The characteristic details are a frame to which horses may be attached; the *coulter* which cuts the side of the furrow; the *share* which cuts the bottom, and the *mould board* which turns it over. The depth of cut is regulated by the *gauge wheel*, while adjustments of the *clevis*, to which the harnessing is attached, serve to alter the width of the furrow.

Plow Foot.—The lower or bottom part of a plow.

Plow Head.—The draught iron at the end of the beam of a plow.

Plowing.—1. In woodworking, cutting and planing grooves and furrows in wood by means of a special tool or *plow*.

2. In bookbinding, the process of cutting and smoothing the edges of a book preparatory to binding or gilding.

Plowshare.—The part of a plow which cuts the ground at the bottom of the furrow, and raises the slice of earth or sod to the mould board, which turns it over.

Plow Steel Wire.—A name given to a wire of very high quality originally used in the manufacture of steel ropes for use with steam plows. It has a very high tensile strength.

Pluck.—To pull with sudden force or effort, or to pull off, out, or from, with a twitch.

Plucker.—In worsted manufacture, a machine having spiked rollers which open out the knots and snarls in the long wool, the latter being fed up to it by a traveling apron.

Plug.—1. A general term for a piece of any suitable material or form used to fill up a hole, the object usually being to prevent leaks.

2. The act of closing a hole by means of such a plug.

3. The movable part of a tap, cock or faucet.

4. A tapered piece of iron or brass, with a male thread. Used to screw into a pipe or fitting to close an opening.

Plug and Collar Gauge.—A pair of standard cylindrical gauges, male and female. The plug or internal gauge is a straight accurately ground cylinder, with a handle prolongation; the collar or external gauge is a bored ring of sufficient size to withstand distortion in use.

Plugging.—In a steam boiler, closing a leak or aperture by means of a screwed stopper.

Plug Pipe.—A short piece of pipe, screwed with a male thread at one end, and closed or welded at the other, used as a plug to close another pipe or an opening in a fitting, when a proper plug is not obtainable.

Plug Tap.—A cylindrical tap for making internal threads by hand; the second one applied, of the customary set of three.

Plug Tree.—The rod that works the double beat or poppet valves of a beam engine.

Plumb.—Perpendicular; that is, standing according to a plumb line.

Plumbago.—Graphite or "blacklead"; used for crucibles and lubricating and also to coat non-conducting surfaces; as, gutta-percha; it is the composition from which the interior of pencils is filled.

Plumb and Level.—A name given to a spirit level which has two vials, one at right angles to the length of the instrument, so that the perpendicularity of walls, etc., may be *plumbed*, as well as horizontal *levels* tested.

Plumb Bob.—An instrument for denoting whether anything stands exactly vertical or perpendicular.

Plumber.—One who works in lead, especially, one who installs lead pipes and other apparatus for the conveyance of water.

Plumber Block.—A metal box or case containing the pillows upon which the journals of shafts revolve, said especially of the shafts of steam engines; the same as plumber box.

Plumber's Furnace.—A portable soldering furnace, made to burn charcoal or gasoline, and used for melting solder, etc.

Plumber's Saw.—A saw having the blade of the same width as the handle, usually having teeth on each edge, tempered for cutting lead pipe.

Plumber's Solder.—That composed of one part tin and two of lead, melting at 440° Fahr.

Plumber's Torch.—A lamp constructed with a thin triangular container for oil, so that it may be used in narrow and confined spaces; as, for illuminating between a pipe and a beam or joist. A screw cap fits over the wick to prevent leakage when it is carried in the tool basket.

Plumbery.—A plumber's place of business; articles made from lead, collectively; lead work.

Plumbing.—The art of working in lead, from the Latin, *plumbum*, lead. The work of the plumber lies chiefly in manipulating leaden sheets and pipes to various desired forms, but also includes the use of other materials, such as brass, iron, or stone-ware, in connection with water supply, baths, drainage, heating, ventilation, and sanitary arrangements of houses and buildings generally.

Plumb Line.—1. A line having a weight attached to its end; used to determine a perpendicular; a plummet.

2. A line perpendicular to the plane of the horizon; a line directed to the center of gravity in the earth.

Plumb Rule.—A narrow board having a plumb line suspended from its top, used by builders to determine a perpendicular.

Plummet.—1. A long piece of lead attached to a line, used in sounding the depth of water.

2. An instrument consisting of a piece of lead fastened to a line, and used by carpenters, masons, etc., in adjusting erections to a perpendicular line, and with a square, to determine a horizontal line.

Plunge.—1. To cast suddenly into water or the like, or to submerge with rapidity and violence.

2. To sink suddenly or to dive; to sink like lead.

Plunger.—A solid cylindrical body which fits accurately or approximately the chamber within which it reciprocates. It differs from a piston in that it is longer than its stroke. A plunger is guided by a stuffing box, either internal or external, while a piston is guided by the cylinder walls. Used in dashpots, and in many mechanical movements: also in a *plunger pump*.

Plunger Pump.—A reciprocating pump for working against comparatively high pressures, the *plunger* or *ram* being a solid cylindrical piece which is moved in and out of the pump chamber, its displacement at each stroke theoretically corresponding to the amount of liquid drawn into the pump and then expelled.

Plural.—Containing or consisting of more than one; opposed to *singular*.

Plus.—The mathematical sign or symbol of positiveness or of addition, +; opposed to minus, —, the negative sign or symbol of subtraction.

Plush.—A fabric used largely in railway cars; it is a cloth usually of wool or cotton, having a cut pile on one side commonly longer than that of velvet.

Pluviograph.—A recording rain gauge; an instrument registering the depth, time of occurrence, and rapidity of rainfall upon a given area.

Ply.—1. To use with diligence, as to *ply* the oar; to work.

2. To go back and forth between points; as, between New York and Liverpool.

3. A web layer or thickness, as the *ply* of belting.

Pneumatic.—Of or pertaining to air, gases, elastic fluids, etc. The term is generally restricted to matters connected with the nature or use of *air*, either under a partial vacuum or under a plenum or pressure.

Pneumatic Caisson.—An air tight structure resting on the channel bottom, like an inverted dish, held down by immense weights, and admitting workmen by means of air locks, after the water has been driven out by pneumatic pressure.

Pneumatic Cushions.—In mechanics, a case or bag made of elastic material and filled with air.

Pneumatic Despatch.—The conveying of letters, etc., from point to point, by means of carriers blown through tubes. The letters, telegrams, etc., are placed within a *carrier*, or cylindrical tube of gutta percha covered with felt; a *skirt* of felt expands to fit the interior of the tube and prevents air leaking past, while the front of the carrier has a buffer of felt discs. The pipes are of lead, the joints being "wiped" around a steel mandrel to insure uniformity of size, while the pipe is enclosed in another of cast iron to protect it. A speed of 20 to 30 miles per hour is maintained; either vacuum or pressure systems are employed.

Pneumatic Foundations.—Foundations excavated by means of caissons under compressed air; the sunken caissons, when filled with concrete or masonry, forming the supports for the footings of the structure to be erected.

Pneumatic Hammer.—1. A power hammer, in which force is given to the blow by means of air compressed behind a piston, as the tup or ram is lifted.

2. A hand tool, worked by compressed air, by which a chisel, caulking tool or riveting set is held up against the work, while a small hammer head, within the handle, is blown upon the head of the tool, giving rapid and effective strokes.

Pneumatic Hoist.—A lifting machine, in which the power is applied by compressed air acting upon the pistons of long stroke cylinders; the movement of the pistons is multiplied by a system of pulleys, thus giving a wide range of motion and high speed.

Pneumatic Painter.—An amplification of the familiar atomizer for spraying perfume. Air is compressed into a reservoir, by means of a hand force pump, while

another reservoir is filled with liquid paint or whitewash, tubes leading from either reservoir to spraying atomizers. The operator has complete control of the spray, and is able to cover parts inaccessible or neglected by the brush, while a larger surface is covered with an equal weight of pigment.

Pneumatic Pressure.—That exerted by compressed air or other gas. In a steam engine, it may be also that exerted by the weight of the atmosphere, owing to an imperfect vacuum being formed on the opposite side of the piston.

Pneumatic Riveter.—A riveting machine, in which compressed air is employed to close the rivets, working upon a piston, to the rod of which is secured the riveting snap.

Pneumatics.—The science which deals with the mechanics of gases, more especially of air, under a plenum or under a vacuum.

Pneumatic Sewerage.—A method of removing sewage from low lying districts by means of ejectors, worked by compressed air, which force the sewage to higher levels. The lifts are provided with two chambers which work alternately, one filling while the other is emptying, the air being supplied from a central compressing station and worked by means of float valves on either ejector chamber.

Pneumatic Stamps.—Crushing stamps in which rotation of the machinery compresses air in a cylinder above the lifters, thus increasing the force of the blow.

Pneumatic Syringe.—An experimental device, consisting of a tube closed at one end, and provided with a tightly fitting piston. It is used to demonstrate the elasticity of air, by its self expansion after pressing the piston down, or to show the heat of compression by demonstrating its igniting qualities.

Pneumatic Tire.—A tire fitted to the wheels of bicycles, automobiles, etc., consisting usually of two tubes, the outer of india rubber, canvas and other resilient but wear resisting material, the inner, composed of nearly pure rubber, which is inflated with compressed air to maintain the outer tube in its proper form.

Pneumatic Tools.—Compressed air is used for operating many small tools which formerly were driven by hand or by water power, or by running cords or

ropes, the application being of especial value where portability is required. The compressed air is brought in flexible rubber armored tubes to the tools.

Pneumatic Tube.—The tube laid for a *pneumatic despatch*. It consists usually of lead, enclosed for protection in an outer pipe of cast iron or stone ware. The tubes, when drawn, are laid in wooden troughs to prevent damage and are made smooth and polished internally by drawing a steel mandrel through. When laying the tubes, a chain is passed through the new length, to this is attached a steel mandrel, slightly smaller than the bore of the tube, and heated. The mandrel is stuck half way in the length last laid and the new length is forced on the mandrel until the ends butt, when an ordinary wiped joint is made. The joint is thus kept the same size and as smooth as the rest of the pipe, also being perfectly air tight. When completed the mandrel is drawn out by means of the chain, and all is ready for making a fresh joint, the enclosing pipes being laid around the leaden tube as each length is completed.

Poak.—In tanning, waste matter from the preparation of skins, consisting of hair, lime, oil, etc. Also spelled *poake*.

Pocket.—1. A small bag or pouch, especially a pouch attached to a garment; a cavity, opening, or receptacle.

2. A dead end or part of a boiler in which sediment is deposited through design or defective circulation; a self feeding hopper bunker opening on the stokehole plates.

3. In mining, a cavity filled with veinstone and ore, or a swelling of the lode, forming a nearly isolated mass.

Pocket Knife.—A knife having one or more blades, which fold into the handle, for carrying in the pocket; a penknife.

Pockety.—In mining, said of a lode or placer; characterized by pockets.

Pod.—The lengthwise groove or channel in certain augers, bits and gimlets; also a bag or pouch.

Pod Bit.—A tool for boring wood, having a cutting lip at its end.

Point.—In mathematics, that which has neither parts nor magnitude; that which has position but neither length, breadth nor thickness.

1. The sharp end of anything; as, of a pin, needle, or knife.

2. The extremity of anything, more especially that which is remote from an enlarged end or head; as, with a bolt or rivet.

3. A punch, used by stone masons to make small furrows over the surface of a stone which has afterwards to be dressed down.

4. A wedge shaped chisel, used to dress ashlar.

5. An engraving tool used by etchers.

Point Blank.—Directed in a line towards the object aimed at; hence, direct; plain; unqualified; as, a point blank answer to a sudden question.

Pointer.—A needle or hand on a dial; a traveling or stationary index on a scale; an indicator to show direction or the like.

Pointing.—In building, finishing the external joints of brickwork or masonry so as to give a neat appearance to the work, or repairing the same when the mortar has become decayed. The mortar or cement is raked out from between the bricks or stones to ascertain depth, and replaced by new, which is finished off to a desired outline by means of a tool or sleeper known as a jointer.

Point of Sight.—In drawing, that point within the eye, where the lines or rays from the object cross or focus each other.

Points.—In railways, a switch; a contraction of *split points*, as the tongue rails are split or tapered off to a point to lie snugly against those of the main line.

Poise.—To balance; to make of equal weight; as, to *poise* the scales of a balance; to hold or place; equilibrium.

Poisons.—Any substance that, taken into the system, acts in a noxious or deadly way upon it; they may be classified as vegetable, mineral, and gaseous poisons.

Poke.—1. A pocket or small bag; a sac blown up with air and used as a buoy by fishermen.

2. To push or thrust against or into.

Poke Hole.—The opening of a heating furnace, to give access to the fire bars for cleaning and stirring with a poker.

Poker.—1. An iron or steel rod used for poking a fire.

2. An iron instrument with a flat foot at one end and a round knob at the other, used for driving hoops.

Polacca.—In navigation, a vessel with two or three masts, used in the Mediterranean. The masts are usually of one piece and without tops, caps, or cross trees.

Polar.—1. In geometry, proceeding from a fixed point of radiation.

2. In geography, of or pertaining to either of the poles of the earth; whether the geographical or magnetic poles.

Polariscope.—An optical instrument for examining substances in polarized light, and useful for ascertaining the amount of actual sugar in commercial sugars; it is therefore the chief use of the instrument. Certain crystalline forms show different colors in the polariscope, and it is therefore employed to identify minerals, precious stones, or to investigate rock structures.

Polarity.—1. In physics, the quality of having opposite poles; as, the *polarity* of the earth.

2. In geometry, a property of the conic sections, by virtue of which, a given point determines a corresponding right line and a given right line determines a corresponding point.

Polarized Light.—A ray of light, ordinarily capable of being reflected or refracted in any direction, which has been *polarized* or constrained so that its vibrations are restricted to one direction only.

Pole.—A long slender piece of wood, commonly tapered and more or less rounded; a tall slender stick or mast fixed upright in the ground; a long rod of wood or metal, used for stirring; as, in glass making.

Pole Axe.—An axe fixed to a pole or handle; or rather, a sort of hatchet with a handle about five feet in length, and often with a point or claw bending downward, or projecting from the back of its head.

Pole Drill.—In well boring, a system where a rigid connection is used between the drilling tools and the reciprocating beam.

Pole Hammer.—In painting and decorating, a hammer on a very long pole, used in a place where it would be impossible to reach with the common hammer.

Pole Hook.—In carriage and wagon making, the hook on the end of the tongue.

Pole Lathe.—In machinery, the primitive form of lathes, so called, because each downward movement of the treadle was made to impart a similar movement to the end of an elastic pole fixed horizontally overhead. A cord slung from the pole was turned round the work and rotated it towards the tool. On the release of the treadle, the work was rotated in the opposite direction. Hence half the time was lost in the return movement, and the tool had to be drawn away after each cut. The pole lathe is still in use in some Eastern countries.

Pole Mast.—A mast formed of a single piece of timber from one tree.

Pole Measure.—A long measure made of a thin slip of board, marked by feet and inches, at times for convenience, used in bridge and erecting yards instead of the tape measure.

Pole Plate.—In building, a small wall plate, bearing the lower ends of the common rafters, and resting on the ends of the roof tie beams.

Policy.—The writing or instrument in which a contract of insurance is embodied; an instrument in writing containing the terms and conditions on which one party engages to indemnify another against loss arising from certain hazards, perils, or risks to which his property may be exposed. Used also for the writing which insures against other events, as well as against loss of property.

Poling.—1. In copper refining, an operation in which a large pole of green birch or oak is thrust down to the bottom of the furnace containing the molten copper. Violent boiling ensues, consequent on the liberation of oxygen from dissolved oxides of copper. Frequent assays are taken, and when the specimen shows by its long silky fracture that the poling process has been sufficiently prolonged, the copper is ladled off.

2. In mining, a method used to support the roof of a tunnel which is being driven through unstable formation. Long narrow boards, laths, or poles, rest at a slight inclination on the top of two trestle like frames, the size of the excavation. As the work progresses, the boards are driven forward, thus keeping pace with the pick, and when projecting sufficiently far, a fresh frame is erected to support the hanging end, the process being continually repeated.

Poling Boards.—In civil engineering, the boards or planks used as lining for a trench, to retain the earth during excavation. Vertical boards are employed, being retained in place by longitudinal *walling pieces*, which in turn are stayed from one side to the other by *struts*. Poling boards are about 3 feet long, from seven to nine inches wide, by 1½ inches thick. They are driven down and fresh ones added as the trench proceeds downwards.

Polish.—To make smooth and glossy, usually by friction; as, to polish glass, marble, metals and the like.

Polishing.—In cotton manufacture, the process of burnishing the threads by brushing after they have been sized.

Polishing Stick.—In machine work, a couple of strips of wood used with emery for polishing work while it revolves in the lathe. The ends furthest from the workman are united with hinges, those nearest him serve as handles, by which the strips are made to tightly embrace the work. The opposed

faces of the sticks are hollowed out where they hold the work; emery cloth or powder intervening.

Polishing Wheel.—A wheel or disc covered with, or composed of, abrading material for polishing a surface.

Poll.—The large or broad end of a machinists' hammer, as distinguished from the *pene* or *pene end*.

Poll Pick.—A mining pick, having one pointed arm about twelve inches long, and the other arm a stump or poll having a steel face for use as a hammer.

Polygon.—A plane figure bounded by straight lines called the sides of the polygon. The least number of sides that can bound a polygon is three.

Polyhedron.—A solid enclosed or bounded by plane faces, especially if there are more than four sides.

Polyscope.—A glass which makes a single object appear as many; a multiplying glass.

Polytechnic.—Comprehending or relating to many arts and sciences; applied particularly to schools in which many branches of art and science are taught, with especial reference to their practical application. Also an industrial exhibition.

Pommel.—1. The knob, ball, or protuberant part on anything to provide a means of grip, etc.; as, the high part of a saddle.

2. A block of hard wood, grooved like a crimping board, which is employed by curriers to render leather supple and impart a grain to it.

Pond.—An enclosed body of water, and usually of less extent than a lake.

Ponderous.—Very heavy; weighty; as, a ponderous load.

Pontil.—An iron rod, used by glass makers in manipulating the hot plastic glass, the bulb or cylinder being transferred from the blowing tube to the pontil, the tube end being then cut or nicked off.

Pontoon.—A floating dock; a buoyant cylindrical or other body used to support weights in the water; lighters used to sustain a floating bridge.

Pony Planer.—A very small planing machine, used by fine tool makers and surgical instrument makers.

Pony Truck.—On a locomotive, a two wheeled bogie or truck, having ordinary axle boxes, working in the guides of a cradle controlled by a triangle of bars, having a pin in the center line of the locomotive.

Poop.—1. In shipbuilding, the aftermost, highest part of the hull.

2. A deck over the afterpart of a spar deck, abaft the mizzen.

3. In carpentry, the roof truss.

Poplar.—A tall straight tree of which there are many varieties. Owing to its rapid growth it is frequently planted as a shade tree or for ornamental purposes. Its wood is of a soft light color, easily worked and not liable to split. Its great use is for paper pulp.

Poppet Head.—In a lathe, either headstock between the centers of which the work is mounted; specifically the tailstock or loose headstock, that one which supports the end of the piece operated upon as distinguished from the mandrel head which rotates it.

Poppet Valve.—A disc or drop valve, as employed for many types of steam and gasoline engines: the term implies that the valve is not completely operated by positive means, usually seating itself through gravitation or by means of springs, and frequently opening by suction or a cam.

Pop Safety Valve.—A spring-loaded safety valve so constructed that it suddenly opens widely at a determined pressure, hence the name. Frequently these valves are muffled, and so deaden the sound.

Porcelain.—The finest and most beautiful variety of pottery, also commonly known as *china*, from first being produced in that country. It is made of the finer qualities of clays and earths, and fired at a high temperature in the kiln, which effects a complete change in the nature of the material, converting it from clay into a highly vitrified state: translucent, non porous, and resonant when struck.

Porch.—In architecture, a covered and enclosed entrance to a building, forming a vestibule to a doorway.

Pore.—In physics, a minute orifice, opening, or perforation in any substance, resembling a pore.

Porgy Oil.—Obtained from the porgy, a name given to various fishes of the North Atlantic and Mediterranean.

Port.—1. In steam engineering, an opening or passageway through a cock, or valve; a passage whereby steam or other fluid may enter or leave a cylinder.

2. The left hand side of a ship looking forward; distinguished by a red side light.

3. In a locomotive cylinder, with common slide valves, the steam ports are rectangular passages leading from the valve face to either end of the cylinder, while the exhaust port is a cavity in the valve face communicating by means of the blast nozzle with the atmosphere.

Portable Drilling Machine.—One which is taken to the work as distinguished from one to which the work is brought. A loosely applied term, covering a variety of machines from a small ratchet drill, to one weighing several tons, driven by its own motor.

Portable Forge.—A blacksmiths' forge of small size, the hearth, bellows or fan, hood, etc., being usually mounted on a skeleton frame, the whole being constructed so that it may be easily transported.

Portable Railway.—A system of constructing light lines of narrow gauge, in which the two lengths of rails, fastened beforehand to metallic ties, are easily handled by a few men, rapidly laid down and connected. Generally, with a portable railway, everything, locomotives, cars, switches, track and accessories, are purchased complete and are used on temporary projects.

Portable Steam Engine.—An engine, with a boiler, mounted on wheels so as to admit of being moved about, from place to place.

Portal.—1. A door, opening or gateway; properly the entrance to a great or magnificent structure.

2. The entrance to a tunnel or adit.

Porter.—1. One who carries burdens, or transports commodities by carrying them; anything used to bear, carry or support.

2. A bar or shaft welded to a forging to act as means for manipulating the latter under the steam hammer or press.

Porter Governor.—A development of the pendulum governor, in which the

centrifugal force is counterbalanced by a weight upon the spindle, thus permitting the governor to run at a much higher speed than when unweighted.

Portland Cement.—A calcined compound of chalk and clay, subsequently ground to fine powder. It possesses the valuable property of hardening under water.

Port Opening.—In a steam engine, the distance the steam edge of the valve moves past the steam edge of the port during admission; sometimes greater than the port width.

Port Side.—On shipboard, the left hand side, facing forward.

Position.—1. A place held and occupied; an office or post; situation.

2. An arithmetical method of discovering the value of an unknown quantity by "trial and error." One or more values are assumed and the result obtained is checked by known data, and the final adjustment made.

Positive.—1. That which is actual and certain, not admitting of any doubt or qualification.

2. Anything rendered certain by the position in which it is placed or the constraint exerted upon it. A *positive* motion is transmitted by toothed wheels, cranks, etc.; a *positive* connection is made by means of a bolt or key, in each case the uncertainty of friction being eliminated.

3. In mathematics, that which is greater than zero; that which has to be added.

Positive Feed.—The feed of a lathe or other machine tool is said to be *positive* when the motion is communicated directly through spur or worm gearing, without the intervention of belts or friction clutches.

Positive Motion Loom.—In weaving, a special loom for wide fabrics, in which the shuttle is pulled to and fro on a raceway by means of a cord, instead of being struck by the picker staff.

Positive Quantity.—In mathematics, a non-negative or affirmative quantity; one that has to be added, being indicated by the sign plus (+), expressed or understood.

Post.—1. An upright piece of timber, metal or other material used as a support.

2. In mining, a pillar of coal or ore left as a support for the roof of a mine.

3. In paper making, the pile of alternate sheets of paper and felt arranged by the couchman for pressing, in the hand process.

Postal Car.—In railway engineering, a railway car specially arranged for the reception, distribution, and delivery of mail matter. Some parts of the car are occupied by letter cases arranged in semi-circular form and by distributing tables; the remainder is used as a *through mail room*, where the bags are placed when ready for distribution. A *bag catcher*, which snatches the mail bags from cranes at the different stations as the train passes by, is fixed to each door of the car.

Post and Girder Construction.—A recommended method of building wooden structures, the various floors and ceilings being supported by stout girders which in turn are supported by posts of wood, cast iron or steel. The practice of supporting floors on wooden partitions leads to numerous disadvantages, and gives less security in case of fire.

Post Drill.—A drilling head which may be bolted to the side of a post, standard or pillar, thus being useful for temporary purposes, as it requires no foundation.

Post Hanger.—A hanger or shafting support, intended to fasten to the side of a post, or standard. Its general appearance is a double bracket between whose arms are fixed the ball and socket or swiveling bearing.

Post Hole Auger.—A cylindrical or stirrup shaped instrument furnished either with a crown or a disc cutter; used for boring holes for the insertion of fencing posts, etc.

Postpone.—To defer to a future or later time; to put off; also, to cause to be deferred or put off.

Postscript.—A paragraph added to a letter after it is concluded and signed by the writer.

Postulate.—In mathematics, a problem, the solution of which is self-evident.

Pot.—A round vessel made of earthenware or metal, rather deep than broad, used in various trades; as, the *glass pot* in glass-making and the *melting pot* in tinning.

Potash.—A crude impure form of potassium carbonate originally obtained by evaporating the leachings of wood ashes. Plants possess the property of separating and assimilating potassium salts from the rocks and soils, the original source being *potash feldspar*, a double silicate of aluminum and potassium, present in granites. The ash is treated

with water and the solution evaporated in pots, hence the name *potash*. On repeating the process, a clearer product, known as *pearlash*, is obtained.

Potash Lye.—A strong solution in water of caustic potash; much used in the manufacture of carbon anhydride (carbon dioxide) as it has such a great affinity for that gas, and absorbs it readily.

Potassa.—A term formerly employed to denote that metal now known as potassium.

Potassium.—A bright, silvery white metal, of a specific gravity of .875, melting at 155° Fahr. It oxidizes very readily, so has to be kept submerged in naphtha, which contains no oxygen. Being lighter than water, it floats when thrown into that liquid, at the same time decomposing it, forming potassium hydrate, and liberating part of the hydrogen of the water. The chemical action is so violent, that this escaping hydrogen ignites, burning with a lavender colored flame.

Potassium Carbonate.—This was formerly obtained as *potash* from wood-ashes, but is commercially manufactured from chlorides, such as *carrollite*, exactly the same as sodium carbonate is manufactured from salt by the *Leblanc process*. It is the source of most of the other potassium compounds.

Potassium Chlorate.—In chemistry, a salt of chloric acid; also called *chlorate*.

Potential.—Having capacity for existence, but not yet existing; anything that may be possible. In electricity, the pressure of an electric charge.

Potential Energy.—Energy that exists by virtue of *position*, as opposed to motion; non-active energy. Water stored in an elevated reservoir represents potential energy, as its liberation to a lower level may be utilized to effect work.

Pother.—Bustle; confusion; flutter; bother; to make a bustle or stir; to be fussy.

Potmetal.—1. Glass in a state of fusion; hence, potmetal glass is that which is colored while in a melted state.

2. An alloy of copper and lead formerly used in making large vessels.

3. A mixture of cast iron used in making hollow-ware.

Potter.—One who makes articles and vessels of porcelain or earthenware, from clay or similar material in its plastic state.

Potters' Lathe.—The wheel or revolving table used by potters.

Potters' Wheel.—A horizontal revolving table mounted on a vertical spindle, upon which a potter forms plastic clay into circular forms, either by hand or by the aid of profiling or shaping tools.

Potttery.—1. Wares, vessels, utensils and the like, produced by the potter's art, whether glazed or unglazed.

2. A factory where pottery and earthenware are made.

Pottle.—1. A liquid measure, usually containing two quarts; a large tankard.

2. A small wicker basket for carrying small fruit.

Pot Valve.—A safety valve shaped like an inverted pot. It is a *lift valve* and the conical pivot of the lever drops loosely into a recess in the crown of the pot. The advantage claimed is that such valves being in a condition of unstable equilibrium, are less liable to *stick* than the ordinary form. The lift of the valve is controlled and maintained by a guide, cast on the top of the seating.

Pouch.—A small bag or sack, or something serving a similar service, as a pocket; on railways, the strong leather receptacle in which mail bags are enclosed for exchanging with a mail train while in motion by means of a specially devised apparatus.

Poudrette.—A fertilizer made from manure, dried and mixed with charcoal, gypsum, etc.

Poultice.—A mollifying and soothing remedy for inflamed surfaces and sores; as, a mustard poultice. These outward applications are useful to relieve sudden cramps and pains due to severe injuries, sprains and colds. The secret of applying a mustard is to apply it hot and keep it so by frequent changes; if it gets cold and clammy it will do more harm than good. Poultices to be of any service and hold their heat should be from one half to one inch thick. To make one: take flaxseed, oatmeal, rye meal, bread, or ground slippery elm; stir the meal slowly into a bowl of boiling water, until a thin and smooth dough is formed. To apply it, take a piece of old linen of the right size, fold it in the middle; spread the dough evenly on one half of the cloth and cover it with the other.

To make a "mustard paste" as it is called, mix one or two tablespoonfuls of mustard and the same of fine flour, with enough water to make the mixture an even paste; spread it neatly with a table knife on a piece of old linen, or even cotton cloth. Cover the face of the paste with a piece of thin muslin.

Pounce.—1. A fine powder, such as pulverized gum sandarach or cuttlefish

bone, formerly used to prevent the spread of ink on paper, or to dry it up; practically superseded by blotting paper.

2. Pulverized charcoal, colored chalk, black lead or other material used as pounce.

Pounce Bag.—In lace making, the bag containing charcoal dust or some other colored powder for making patterns through perforated designs; used also by embroiderers and draftsmen.

Pounce Box.—A perforated box for holding pounce for drying the ink on documents. In France and some other countries a legal paper is not permitted to be dried with blotting paper.

Pouncing.—1. The operation of transferring a design from paper to a surface upon which it is to be reproduced, by dusting powdered charcoal, from a linen bag, through small holes perforated along the outlines of the drawing. The marks left by the pounce dust are then united with a soft lead pencil.

2. In hat making, the process of revolving the hat body against a rotating cylinder covered with sand paper which shaves off loose fibers, and grinds up a nap to the proper surface.

Pouncing Machine.—In hat making, a machine for smoothing the exterior surfaces of felt hats by means of an abrasive agent while the hats are being rapidly revolved.

Pound.—1. A certain specified weight; especially, a legal standard consisting of an established number of ounces; as, the pound avoirdupois, which is divided into 16 ounces, and the pound troy, which is divided into 12 ounces. 144 pounds avoirdupois are equal to 175 pounds troy weight.

2. A British denomination of money of account, equivalent to 20 shillings sterling, and equal in value to about \$4.84. There is no coin known by this name, but the gold sovereign is of the same value.

3. A knock or bump occurring in running machinery through slackness of the parts, or one piece coming in contact with another.

4. To break up and reduce anything to a powder by means of blows.

Poundage.—To tax or assess at a given rate per pound; collect at such a rate. In salt manufacture, the amount of salt yielded per cubic foot of the brine.

Poundal.—The British unit of force; that force which, acting on the mass of a pound for one second, increases its velocity by one foot per second. It is equal to the weight of a pound mass divided by the acceleration of gravity; that is, 13,825 dynes or about half an ounce.

Pounding.—1. The act of beating, breaking up or disintegrating by means of blows, reducing to a powder.

2. Thumping or knocking in a marked degree, on the part of running machinery, either through slackness or disarrangement of the moving pieces.

Pound of Steam.—A pound of water which has been converted into steam. After such a change (i. e., water into steam, or the reverse), the weight approximately remains the same.

Pour.—Continuous flowing of any liquid; as, a *pour* of water. In founding, the amount of material, as melted metal, poured at a time; as, to make a *pour* at noon.

Pouring Gate.—In founding, the opening through which molten metal is poured into the mould; also known as gate, git, ingate, inset sprue and tedge.

Powder.—1. Any dry substance composed of very minute separate particles, produced either by natural or artificial processes.

2. A composition of saltpetre, sulphur and charcoal, used as an explosive or propellant; the same as gunpowder.

Powdered Coal.—Coal that has been broken or ground into minute fragments. Used as fuel in the rotary kilns in which Portland cement is clinkered; as firing for various brickmaking processes, and as part of the composition of certain porous tiles and bricks, the coal burning out as the articles are fired, leaving them in a spongy or porous state.

Powder Mill.—A mill in which powder is made.

Power.—1. Ability to act; strength; force; energy or action; as, the power of steam in moving an engine.

2. In mechanics, the rate at which work is done; that is, work divided by the time in which it is done. The most common unit of power is the horse power, or 33,000 foot pounds per minute.

3. The product arising from the multiplication of a number into itself; as, a cube is the third power of a number.

Power Boat.—A small craft propelled by a motor other than steam.

Power Gas.—Any gas that is used for driving gas engines. It includes the waste gases from blast furnaces. The thermal value is less than that of illuminating gas, but with full allowance for

this, it is so much cheaper that an enlarged demand for gas engines has been created.

Power House.—A central station; a structure where engines, steam boilers, electric motors, etc., are gathered, from which central point power is disseminated.

Power Lift.—A platform or cage working in suitable guides, and operated by hydraulic or other power, used to raise or lower weighty articles; an elevator used for transporting other than passengers.

Power Loom.—A loom worked by water, steam, or some mechanical power.

Power of a Number.—In mathematics, a number multiplied by itself any number of times; the result of taking a number any given number of times as a factor; as, the 4th, 5th, 6th, etc., power of a number is found by multiplying the number by itself 4 times, 5 times, 6 times, etc., as the case may be.

Power Plant.—The assemblage of parts, machinery, etc., connected with the generation, control and supply of power; as, in a works, etc.

Power Station.—The central point where power is generated, and whence it is distributed to desired localities.

Power Transmission.—Distribution of power from central plants to a number of more or less scattered points, thus securing the economy consequent upon large and compact units, which may be situated advantageously near sources of water power, coal mines, etc. The chief methods of transmission are *wire rope* for short distances, *hydraulic*, *pneumatic* or *electric* power for longer, each plan having special advantages for certain purposes.

Practical.—1. Capable of being turned to use or account; useful, in distinction from theoretical; for all practical purposes.

2. Evincing practice or skill.

3. Ready to apply knowledge to some useful end; as, a practical man.

Practice.—1. Skill or dexterity acquired by use; expertness; an exercise of an art, or the application of a science in life; actual performance; application of knowledge; opposed to *theory*.

2. An easy and concise method of applying the rules of arithmetic to questions which occur in trade and business. Also spelled *practise*.

Precinct.—The limit or exterior line encompassing a place; a boundary; a confine; a district within certain limits.

Precious Metals.—A name frequently given to gold and silver on account of their superior value as compared with most other metals.

Precipitate.—A substance which, having been dissolved, is again separated from its solvent, and thrown to the bottom of the vessel, by pouring in another liquor.

Precipitation.—The act of throwing down; specifically, the deposition, as sediment, of any substance dissolved in an acid solution on the addition of an alkaline reagent.

Precise.—Accurate; exact; definite.

Precision.—Strict conformity to a rule or standard, exactness; accuracy; as, *precision grinders*.

Preferred Stock.—Shares, as in a manufacturing company, which take a dividend before other shares or stock. Called also preference stock.

Preliminary.—That which precedes the main work, design or business; something previous or preparatory.

Premature.—Happening, arriving, existing or performed before the proper or usual time; adopted too soon; too early; as, a premature explosion of a blast.

Premium.—A reward or recompense; a prize won by being before another or others in a competition; a bounty.

Premium System.—A method of paying workmen by results. A stated time is allotted for the execution of certain work, say 10 hours; should the operative finish it in 8 hours, he receives from $\frac{1}{3}$ to $\frac{1}{2}$ of the time saved; that is to say, is paid 8 hours + $\frac{2}{3}$ or $\frac{3}{4}$ hours for 8 hours' work. The crux of the whole matter lies in the fact, that if the men devise schemes for executing the work quickly, the prices are likely to be cut, and the work has to be carried on at top speed to earn bare wages. Hence, if owners desire to introduce the premium system, they must adhere rigidly to the agreement when once a rate fair to both parties has been settled.

Prentice.—An abbreviation for an *apprentice*.

Preparation.—The act of preparing or fitting for a particular purpose, use, service or condition; previous arrangement or adaptation.

Prepayment.—Payment in advance.

Prerelease.—In steam engineering, the opening of a steam cylinder to exhaust just before the termination of the piston stroke, to reduce back pressure.

Prescription.—A direction of a remedy or of remedies for diseases and accidents, and the manner of using them; a medical recipe; also a prescribed remedy.

Preservation of Timber.—Best effected by using well seasoned timber and keeping it well ventilated. Large posts should be bored longitudinally, with a transverse hole at top and bottom, while a space should be left around all built into masonry. All woodwork in contact with outside masonry, should have the back painted and no chance allowed for lodgment of moisture. Posts to be put in the ground should be dipped in coal tar, or else have the buried parts charred. Timber kept constantly submerged will keep indefinitely, but all exposed to intermittent wetting should be creosoted. Of artificial processes, *creosoting*, as described for railway sleepers, is admitted to be equal to any and better than others, as regards baffling the *teredo*.

Preservative.—1. That which preserves, or has the power of preserving; a preservative agent; as, white lead, used in paint for exposed surfaces.

2. To save from decay, by the use of some preservative substance; as, sugar or salt.

3. To maintain throughout; to keep intact; as, to preserve the steam plant during a period of idleness.

President.—1. A person who sits in the highest or first position in a deliberative assembly or council; hence, the head of any assemblage, especially the chief executive officer of a republican form of government.

2. An executive official of high but indeterminate rank, in an American business corporation. Sometimes, he is chairman of the directorate, more often he combines the two offices of director and general manager, most frequently he is managing director, shaping policies and directing general matters in council with associate directors, while the general manager is a subordinate.

Press.—1. An instrument or machine which works by exerting pressure upon or squeezing the material on which it operates.

2. An apparatus for forming or indenting sheet material into any desired form, without actually separating or dividing it.

3. A drilling machine, in which the feed is applied by means of a lever.

4. A device or mechanism, in which pressure is applied by the employment of a lever.

Pressed Brick.—Brick formed by an instrument or machine by which the clay is pressed or squeezed before being put in the kiln.

Pressed Steel.—Steel plate bent or pressed by means of dies into channel or other sectional forms, giving great strength with a minimum weight of metal. Frames for railway vehicles and motor cars are made in this manner.

Presser Bar.—1. In a knitting machine, a bar which presses the barb or beard of the needle into the shank, to enable it to clear the formed loop.

2. In a sewing machine, the foot or bar which presses on the work and holds it under the needle.

3. In spinning, the spring finger of a bobbin frame.

Press Fit.—In shop work, a fitting of contiguous parts tighter than a *drive fit*.

Pressing.—1. The act or process of submitting to pressure, usually with the object of imparting a desired form to any material while in a plastic state.

2. Compressing "thrown" vessels of pottery into moulds, while still moist, so as to make them of uniform size; also the act of forming handles, etc., for earthenware in moulds, or the process of making flat articles, such as plates, saucers, dishes, etc., under a press.

3. The manufacture of cheaper articles of domestic use, from glass, through pressure by means of lever or screw presses and stoutly made moulds.

Pressing Cage.—A vessel or chamber constructed of narrow steel bars bound together by weldless steel hoops, in which oil bearing materials, such as copra, palm kernels, castor and other seeds are subjected to pressure, in extracting the vegetable oils. The advantages of the cage, over the tank with perforated sides, are larger area for drainage, and freedom from wearing of perforations which leads to escape of meal along with the oil.

Press Rolls.—In paper making, the term applied to two sets of rollers or cylinders of cast iron, which press the water out of the web of paper after it leaves the couch roll.

Pressure.—The action of a force against some obstacle or opposing force.

Pressure Bar.—In a wood planing machine, a piece or bar for pressing the work to the table.

Pressure Blower.—A term applied to signify a *blower* of the rotary type, as opposed to a *fan*, the former producing a definite and constant amount of positive pressure while the latter acts by displacement only.

Pressure Gauge.—A dial instrument for registering the pressure of a fluid or liquid confined within a pipe or chamber.

The usual pattern operates by the tendency of a bent oval tube to straighten itself under pressure. Mercurial columns are used for accurate measurements or for testing mechanical gauges. Inverted syphons containing oil or water are used to measure air pressures, such instruments being often known as *piezometers*.

Pressure Regulator.—Any device by means of which pressure may be regulated, as in a reducing valve, where a high pressure is reduced to a definite lower pressure, maintaining the latter at a constant height irrespective of fluctuations in the higher pressure.

Prevention of Smoke.—This necessary sanitary and economic precaution is effected usually by one of three broad methods: (1) the use of smokeless fuel; such as gas, anthracite coal, etc.; (2) careful and systematic firing, generally effected by means of mechanical stokers; (3) burning the products of combustion before letting them pass into the atmosphere, either in subsidiary furnaces, or by special arrangements of the fireplaces, gas passages, and the like.

Price Book.—A special account book kept to record current prices or costs of materials, etc., used in the processes of manufacture.

Prick.—1. To make a puncture in; to drive a fine point into, etc.

2. That which pricks, penetrates or punctures; a pointed instrument.

Pricker.—1. In blasting, a copper or bronze wire inserted into the charge while the tamping is forced in, so that on its withdrawal a small opening is left for the introduction of the train or fuse.

2. A long pointed crowbar used to dislodge hanging coal from the roof of a mine, or similar purposes.

Pricker Bar.—A toothed bar with which to clean out the spaces between the grate bars in a mechanical stoker.

Pricker Blade.—A broad pointed blade, set at right angles to the extremity of a firing tool, known as the *pricker bar*, whereby the spaces between the grate bars of a furnace are kept clear of ashes or clinker, thus permitting free passage of air through the bars to the fire above them.

Prick Punch.—A finely pointed slender kind of center punch, used for dotting in lines in partly finished work for machine shop processes.

Prill.—In mining, the better parts of ore separated from inferior; a piece of virgin

metal; the resultant "button" from assaying a specimen of ore.

Primary Colors.—Those developed from the solar beams by the prism; seven in number, viz.: red, orange, yellow, green, blue, indigo, and violet, which are reduced by some authors to three: red, yellow and blue.

Primary Powers.—These are: 1, water power; 2, wind power; 3, tide power; 4, the power of combustion; 5, the power of vital action.

Prime.—1. The first or best of anything; of first rank or quality.

2. One of the first numbers; that is, those under ten, which may be counted on the fingers.

3. Any number which contains no factors but itself and unity, such as 3, 5, 7, 11, 19, etc.

4. To add a combustible or rapid explosive to a combustible or explosive mixture, with the object of facilitating deflagration or explosion.

5. To froth or foam in a steam boiler, carrying water over into the engine.

6. In mathematics, a mark (') written above and to the right of a letter or figure; when applied to a figure, it denotes an inch or minute.

Prime Factor.—A number which cannot be divided without a remainder except by itself and unity, as 7, 11, 19, etc.

Prime Mover.—An apparatus or mechanism whereby motion and force are received directly from some natural source of energy, and transmitted into some form of motion by means of which the power may be conveniently applied. The sources of energy are: muscular energy, as the power exerted by men and animals, the man or animal constituting the prime mover; gravity, exemplified in the driving of a clock, by the falling of its weights, or in the operation of a water wheel by the weight of falling water; motion of fluids, as in a windmill; heat, as in a steam engine and boiler, whereby the heat of the fuel is converted into the motion of the crank shaft; chemical energy, as in the firing of a gun, or the generation of electricity in a primary battery.

Prime Number.—In arithmetic, those which are only divisible by unity or one.

Priming.—1. The first coat of paint or the like applied to any surface destined to be painted, glazed or covered with similar material. The object is to fill up pores, roughnesses, or slight inequalities, so that the finishing coats shall present a smooth, unblemished surface.

2. A combustible which communicates fire to a charge of gunpowder, or other explosive; a modification of a train or fuse.

3. The injection of liquid into a pump, so that its chambers are filled, in order that the proper operation may take place; often necessary in starting to lift water from a considerable depth.

4. Injecting a few drops of gasoline into the cylinder of a motor, to produce an explosion at starting.

5. Water carried over with the steam from a boiler to the engine, etc.; due to irregular evaporation, dirty water forming a scum on its surface, undue forcing of the rate of steaming, or else lack of steam space. A sudden opening of a valve may also cause this trouble.

Primitive.—Pertaining to the beginning or origin of things; original; primary.

Principal.—1. The employer, or one who acts as an agent; hence, the first and highest in authority.

2. In steel buildings, a rafter truss, spanning between each pair of opposite pillars or uprights, supporting the purlins, and consequently the roof covering. This type of roof truss is characteristic of iron roofs.

3. A principal rafter, the most important in a roof truss, which runs from ridge pole to wall plate or tie beam.

Principle.—1. A source, or origin; that from which anything proceeds; fundamental substance.

2. A settled rule of action; a governing law of conduct; an opinion or belief which exercises a directing influence on the life and behavior.

Printing.—1. The act or process of making an impression or of marking anything by pressure.

2. The act, art or practice of impressing letter press, designs, engravings and the like on paper, from movable type, engraved blocks, etc. It includes the production of all kinds of matter, books, periodicals, newspapers, posters, circulars, by a variety of processes.

Printing Press.—A machine of various patterns, operated by hand or power, for taking impressions upon paper from movable type or engraved blocks.

Printing Telegraph.—An automatic telegraphic machine which prints the message, as it is received, upon an uncoiling tape or strip of paper. The Morse alphabet or common Roman type is employed.

Prism.—1. A transparent body with, usually, three rectangular plane faces or sides, and two equal and parallel triangular ends or bases; used in experiments on refraction, dispersion, etc. Prisms of different forms are often named from the figure of their bases; as, a triangular prism, a quadrangular prism, a rhombic prism.

2. In optics, etc., a piece of transparent refracting material in the form of a prism, usually with three equal rectangular faces and of triangular cross section.

Prismatic Compass.—A magnetic compass used in surveying, etc. It is usually mounted on the top of a single staff, or

else carried in the hand, being so arranged that, by means of a prism, the graduations can be read at the same time that the object sighted is seen through the sight vane.

Probability.—1. That which is probable or likely to occur; that which has the appearance of truth.

2. In mathematics, the ratio of the chances favoring a certain event to the total number of chances for and against it.

Problem.—1. Anything which is required to be done; as, in geometry, to bisect a line, to draw a perpendicular, or, in algebra, to find an unknown quantity.

2. A question proposed for solution; a matter stated for examination or proof; hence, a matter difficult of solution or settlement; a doubtful case; a question involving doubt.

Process.—Operation; continuous experiment; series of actions, motions or occurrences; progressive acts.

Produce.—1. To cause to grow; to generate; to bring forth; to set plainly in view.

2. To draw out or evolve; to lengthen or extend; as, a line.

Producer.—1. One who produces. An individual who makes, grows or mines things for sale; the opposite to the user or consumer.

2. Any apparatus designed to generate gas or vapor from raw materials; a term of wide application.

3. A retort or generator in which almost any combustible matter, such as coal, coke, culm, wood, tanbark, sawdust, or waste materials may be heated and gasified; the resulting gas being led away and burned elsewhere, as fuel in steel furnaces, etc., or after being scrubbed and filtered, it may be used in specially designed gas engines.

Producer Gas.—A mixture of combustible gases, which is prepared by the combustion of fuel apart from the furnace to be heated. The gases after passing from the gas producer furnace, are heated in regenerators, and mingle and burn on their furnace hearth with atmospheric air similarly heated. Producer gas is prepared from inferior fuel, but chiefly from bituminous coal, and by its employment, a saving of fuel is made and a uniform and more regulable heat obtained.

Product.—1. That which is produced as the result of any operations or processes, natural or artificial.

2. In mathematics, the result of numbers multiplied together.

Production.—1. The act or process of bringing forth, or exhibiting to view.

2. That which is produced, yielded, or made, whether naturally, or by the application of intelligence and labor.

Products of Combustion.—In steam engineering, the combustible parts of coal are hydrogen, carbon and sulphur; and the unburnable parts are nitrogen, water; and the incombustible solid matters such as ashes and cinder. In the operation of firing under a boiler the three first elements are totally consumed and form heat; the nitrogen and water, in the form of steam, escape to the flue, and the ashes and cinders fall under the grates.

Profile.—1. The contour or outline of anything.

2. The outline of a building or projection of a moulding; as shown by a section.

3. A mould of fired clay, used by pottery makers to form the foot of plates or saucers.

4. To shape curved or irregular surfaces in a vertical milling machine which is furnished with a copying attachment, the revolving cutter following the path traced by the former or pattern.

Profile Map.—In civil engineering, a map; as, of a road or railway, showing a base line and the various heights above it, in accordance with definite scales for both horizontal and vertical distances, the latter being usually many times larger than the former, to exaggerate the differences in elevation and present a clearer idea of the nature of gradients, etc.

Profler.—A milling machine having a vertical spindle and horizontal table. It is employed mainly to cut the edges of work, and to sink recesses in the upper face of same. Also called a *profiling machine*.

Profiling Machine.—A type of vertical milling machine, in which the cutter is guided by a copying arm from a former, as in the copying lathe; used for shaping irregular pieces; as, reversing links, parts of gun locks, and many others.

Progress.—1. To advance or move forward.

2. Advance, improvement, development or growth.

Progression.—1. The act or state of advancing or progressing.

2. In mathematics, a series of quantities of which each one, intermediate between the first and the last, bears a constant mean proportion to those immediately before or behind it. Thus in *arithmetical progression*, a series like 3, 6, 9, 12, 15, 18, would denote a progressive multiplication by 3; in *geometrical progression*, the series would advance by self multiplication at each stage, as 3, 9, 27, 81, 243.

Progressive.—Advancing; moving forward; proceeding onward; evincing progress; as, progressive motion or course.

Project.—That which is designed; something intended or devised; contrivance.

Projectile.—1. A part of mechanics which treats of the motion, range, time of flight, etc., of bodies thrown or driven by an impelling force through the air.

2. A body projected, or impelled forward, by force, especially through the air; as, a cannon ball.

Projection.—A part jutting out; as, of a building; an extension beyond something else.

Prolate.—Extended lengthwise; prolonged beyond the outlines of an exact geometric shape. Thus, a prolate spheroid approximates in shape to a lemon or an egg, while an oblate spheroid is more or less orange shaped.

Proliz.—Extending to a great length; unnecessarily long; minute in narration or argument; excessively particular in detail, rarely used except with reference to discourse written or spoken.

Promoter.—One who sets on foot, and takes the preliminary steps in a scheme for the organization of a corporation, a joint stock company, or the like.

Prong.—Any sharp pointed instrument; a sharp slender projection, like the pointed projections of a fork. The term is derived from *poke*.

Prong Chuck.—In wood lathes, a fork-like chuck, whose *prongs* revolve wood which is fastened between lathe centers.

Prong Key.—In machinery, a kind of spanner or wrench, used in tightening up circular nuts by power applied to their faces. Two projections or *prongs* on the front face of the spanner fit two corresponding holes in the nut faces, the leverage being applied to a handle attached to the spanner.

Prony Brake.—In steam engineering, a simple absorption dynamometer, named after its inventor, in which a band encircles the fly wheel or pulley of the engine, and a lever secured to this band is balanced by means of a steelyard or weighing machine at the far end.

Proof.—1. Stress or test to determine soundness or strength of construction.

2. Method of demonstration of correctness; as, in the solving of a mathematical problem.

Proof Bar.—In steel manufacture, the loose bar which is thrust through a hole in the trough which contains steel undergoing the process of cementation, and which is removed from time to time to enable the attendant to judge of the progress of the operation.

Proof of Strength.—In mechanics, being of a certain standard in resisting pressure, bending, etc.; as, said of various materials.

Proof Spirit.—A liquid containing 49 per cent. alcohol, specific gravity .92. The strength of alcoholic beverages is expressed by the excise as *over* or *under proof*: 20 over proof means that the spirit has $\frac{2}{3}$ the strength of proof spirit; 20 under proof signifies that the fluid has $\frac{1}{3}$ of the strength of proof spirit.

Proof Staff.—The metallic straightedge by which millers check the accuracy of their wooden *red staff*. The latter is applied, after covering with red "marking" (ochre or red lead), to the millstones, in order to gauge them during dressing to a proper level surface. The red staff wears away by rubbing on the stone, hence the need for the proof staff.

Proof Stress.—The stress to which an object, such as a gun, cable, or bridge is subjected, to ascertain its strength, by imposing a load on it greater than would be required under normal circumstances.

Prop.—That which sustains a weight; that on which anything rests or leans for support; a stay; as, a *prop* to a building.

Propel.—To drive or push forward; to force to move onward; as, a steamship on the water.

Propeller.—That which transmits the power of the engine to the water; generally speaking, the screw propeller, which is a spirally vaned wheel whose rotation displaces the water, consequently driving the vessel along.

In automobiles, a fan resembling a screw propeller in appearance, which induces a draught through the radiator which cools the circulating water; in air cooled engines the fan drives air over the cylinders to maintain them at a moderate temperature, instead of using water circulation for the same purpose.

Propeller Blades.—The vanes of a screw propeller which thrust on the water.

Propeller Boss.—In marine service, the hub or nave of the screw or propeller, sometimes solid with the blades, in other cases connected to them by studs, etc.

Propeller Pump.—A rotary pump, in which the operating part or impeller is of helical form, somewhat resembling the screw propeller of a steamship.

Propeller Shaft.—In a steamship, that length of shafting on which the propeller is keyed; it is brass lined or else solid bronze, and works in bearings of lignum vitae or white metal. In automobiles, the shaft on which is mounted a fan for air cooling.

Propeller Strut.—A strut, stay or bracket, supporting the long outboard portion of the propeller shaft of a twin screw steamer.

Propeller Wheel.—Consists of two, three or four spiral or twisted blades, fastened to the main driving shaft of a vessel, where it comes through the stuffing box at the stern. Its diameter is the diameter of the circle by the extremities of the arms or blades.

Proper Fraction.—In arithmetic, a fraction in which the numerator is less than the denominator.

Property.—Any object of value that a person may lawfully acquire and hold; anything that may be owned; any object necessary for a particular use.

Proportion.—1. The arrangement of parts; the relation or adaptation of one portion to another, or to the whole, with relation to magnitude or quantity; as, the proportion of the parts of a building.

2. In arithmetic the *Rule of Three*, according to which it is possible, by the theory of proportions, to discover a fourth proportional or term, which shall bear the same ratio to the third, as the second does to the first.

In proportion, three quantities are given, the problem being to find the fourth, as 2 is to 4 so is six to what number, expressed thus: 2:4::6:? The sign :: is an abbreviated form of = and has a like meaning. Each term of a proportion is called a *proportional*; the first and fourth terms are called *extremes*; the second and third terms, *means*. When the two means are the same number, that number is a *mean proportional* between the two extremes.

Proportional Dividers.—Also known as *proportional compasses*; a mathematical instrument consisting of two similar

slotted bars with a point at either end. The bolt, on which the two hinge, may be set to any desired point in the graduated slot, so that the opening at the longer end shall be a definite multiple of the opening at the shorter end. Thus, a measurement taken from a map or drawing is simultaneously multiplied or divided at the other end, facilitating the reduction of drawings to a smaller scale, or enlarging them, as needs be.

Proportions.—Relative dimensions of one part with another, or of the whole with regard to magnitude.

Proposal.—An offer or bid made for the performance of anything; that which is usually understood as a *tender*, or proposed price for which a person or firm offers to execute certain work, to supply specified articles or to buy old materials, etc.; as, a *proposal* to buy.

Proposition.—In arithmetic, something which is either proposed to be done, or to be demonstrated, and that is either a problem or a theorem.

Proprietor.—One who has the legal right or exclusive title to anything; an owner; as, the proprietor of a mill.

Propulsion.—The act or operation of propelling or driving forward; more especially with regard to shipping, etc.

Prospecting.—The act or art of exploring a region for metalliferous or mineral wealth, using such tools and apparatus as may be carried on pack animals and can be wielded by one or two men.

Prospectus.—A summary, plan or scheme of something proposed, affording a prospect of its nature; as, a prospectus of a mining company.

Protoxide.—In chemistry, that one of a series of oxides having the lowest proportion of oxygen.

Protractor.—A mathematical instrument for setting off angles on a drawing or map, etc. In its simplest form it is a limb or graduated semi-circle, marked out to 180°. A hole or notch is provided at the center of its straight base, this being placed on the point whence the desired line starts, the angle being read from the circumference. Better instruments complete the whole circle and are fitted with verniers and pointers so that minutes or even finer gradations may be easily read or set off.

Protuberance.—Any thing which rises above adjoining parts; the term denotes a knob or swelling which raises itself

gradually, as differing from a more abrupt projection.

Prove.—1. To try or ascertain by an experiment, or by a test or standard; to test; as, to prove the contents of a vessel by comparing it with a standard measure.

2. To ascertain the correctness of any arithmetical operation or result.

Proxy.—1. The agency of one who acts as a substitute for another or his principal; authority to act for another.

2. A writing by which one person authorizes another to vote in his place.

Prudent.—1. Sagacious in adapting means to ends; skillful in determining any line of conduct; practically wise; careful; discreet.

2. Dictated or directed by prudence or wise forethought; evincing prudence.

3. Frugal; economical; prudent expenditure of money.

Prussian Blue.—A brilliant blue dye and pigment, prepared by adding potassium ferrocyanide to a solution of ferrous sulphate, the product thus obtained being oxidized with dilute nitric acid.

Prussic Acid.—A volatile, colorless, and extremely poisonous liquid compound, formed by decomposing metallic cyanides with hydrochloric acid.

Public Library.—A library from which certain books can be taken by the public for use at home or elsewhere, under restrictions as to their safe return by the borrowers.

Pudding Stone.—A rock composed of rounded fragments of stone cemented together by another mineral substance; it gains its name from the various vivid colors of the conglomerate, suggesting plum pudding.

Puddle.—1. Clay, mixed with water to form a plastic mass, used to line reservoirs, water channels, cofferdams, etc., where an impervious material is necessary.

2. To mix clay with water, either to separate stones and grit from it, or to make a plastic lining material.

3. To treat cast iron in a reverberatory furnace, for converting it into wrought.

Puddle Ball.—In smelting, a mass of puddled iron as it leaves the puddling furnace.

Puddled Bar.—In iron making, the bar rolled from the shingled bloom in the forge; also known as muck bar from the impurities in it.

Puddling.—The process by which wrought iron is manufactured from cast, the material being known as *forge pig*. The puddling furnace is of the reverberatory type, its hearth having a cast iron bottom, covered or *fettled* with *bull dog* or *mill scale*. The pig is fed to the furnace with a charge of slag, and, as it melts, the slag forms a surface over it preventing oxidation; while molten, the carbon, silicon, etc., are absorbed by the fettling, this raises the melting point, and the iron begins to solidify into a pasty mass. At this point it is *rabbied*, or worked with iron rods, and the mass worked about to bring it into better contact with the ferric oxide of the bed, which absorbs more carbon. The iron is then worked into *blooms* or *balls*, a spongy pasty mass, and removed from the furnace to the *skingling hammer*, where the slag is beaten out of it. After this operation, with the same original heat, it is passed through the rolls, forming *puddled bar*, which is also known, from its contained impurities, as *muck bar*.

Puddling Furnace.—In smelting, a reverberatory furnace in which cast iron is subjected to the action of air to effect the removal of excess carbon, and thus bring it into the condition of wrought iron. Some puddling furnaces are made double; two sets of men being employed, one set on each side at opposite working doors. An increase in output and economy of fuel are thus obtained.

Puddling Rolls.—In rolling mills, the first sets of rolls through which a *bloom* is passed. The first or roughing rolls are grooved in V shaped channels and in diamond shape, the grooves diminishing in depth from left to right along the rolls. Those to the left are distinguished from the others as *roughing rolls* because there the bloom is first embraced. The surfaces of the grooves are roughened with chisel nickings to take firm hold of the blooms. To the right hand are the *finishing rolls* in which the grooves are rectangular in section, to impart that shape to the puddled bar. These grooves also diminish in depth from left to right.

Puff.—To blow in puffs or in short and sudden whiffs; any sudden or short blast of wind, a whiff.

Puffer Pipe.—In manufacturing, the vertical axial pipe in a *kier*, in which cotton goods are washed during the bleaching process.

Pugging.—1. The process of filling spaces between floor joists, or between the thicknesses of partition walls to deaden sound.

2. The material so laid; coarse mortar, felt, sawdust, tanbark, etc.

3. The grinding of clay with sufficient water to render it plastic, the same as *tempering*.

4. The clay ground or tempered in this manner.

5. The act of tamping with clay or puddle.

Pug Mill.—A machine in which clay is cut to pieces by means of moving arms or blades, and is ground and tempered to bring it into a plastic condition suitable for brickmaking or pottery.

Pull.—The act of pulling or drawing with force; an effort to move by drawing toward one.

Pulley.—One of the mechanical powers; consisting, in its simplest form, of a grooved wheel, called a sheave, turning within a movable frame or block by means of a cord or rope attached at one end to a fixed point. The force acting on the free end of the rope is thus doubled, but can move the load only through half the space traversed by itself.

Pulley Block.—An arrangement of pulleys or sheaves within a frame of wood or metal, suitable for arranging as a tackle.

Pulley Boss.—A shop term for the hub or nave of a pulley or bandwheel.

Pulley Clutch.—A driving pulley to which a friction clutch is attached, so that a shaft or machine may be thrown, into or out of gear, at will.

Pulley Rolls.—A sort of skeleton roller employed to support conveyer belting, consisting of a number of uniform pulleys keyed close together on a shaft.

Pulleys and Belts.—When two pulleys are working together connected by a belt, the one which communicates the motion is called the *driver* and the one which receives it is called the *driven* pulley.

Pulling Jack.—A hydraulic or screw jack having the reverse motion of a lifting jack, as its power is employed in shortening itself instead of in extension of its length; it is thus applicable for the purpose of pulling things together.

Pulp.—A moist, soft, slightly adhering mass of matter; a mixture, as of wood-fibers or rags, reduced to a pulpy condition and forming the basis from which paper is made. In mining, pulverized ore mixed with water in or from the stamps or crushing machines; slimes.

Pulsator.—A pump of the pulsometer or aqua-thruster type, in which the direct pressure of steam upon the fluid is employed alternately in either of two oval chambers.

Pulsometer.—An apparatus for pumping liquids by the direct pressure of steam upon the surface of the fluid. It is a modern development of Savary's early steam engine. The steam blows the liquid out of one of the two chambers of the pump, condensing it as it does so, the vacuum thus formed closing the steam ball valve and drawing in a fresh supply of water. The shifting of the ball valve next admits steam into the other chamber, which then discharges and fills itself, sucking the ball to one side and admitting steam to the first chamber for the new stroke. The only moving parts are the ball and the suction and delivery valves, hence there are few repairs needed, and thick liquids may be pumped.

Pulverizer.—A machine for reducing ore or mineral matter to dust or small fragments.

Pumice.—An extremely light stone, full of gas or vapor cavities, thrown off as froth or scum from a volcano, being blown from the surface of liquid lava by steam explosions through the mass.

Pumice Stone.—Pumice used by painters to produce level surfaces and reduce inequalities in paint work, the successive coats being rubbed down with it, the stone having been previously ground smooth on one side to prevent scratching.

Pump.—A hydraulic machine, variously constructed, for raising or transferring fluids, consisting essentially of a moving piece or piston working in a hollow cylinder or other cavity, with valves properly placed for admitting or retaining the fluid as it is drawn or driven through them by the action of the pistons; as, an *air pump*, a *rotary pump*, etc.

Pumping Engine.—A reciprocating stationary engine of large size, designed for pumping water. Such engines have the steadiest load of any land engines, and are usually fitted with every refinement to produce efficiency.

Pumping Jack.—A contrivance for pumping an oil well, whereby the horizontal pull of a jerking line is transformed, by a proper arrangement of guide pulleys and walking beam, into a vertical reciprocating motion of the sucker or pump rods.

Pump Links.—Connecting bars between the pump rods and crosshead in a marine engine, so arranged that the reciprocating motion of the crosshead is imparted to the pump, and the length of stroke reduced by locating the fulcrum near one end of the links.

Pump Speed Governor.—A device attached to reciprocating pumping engines, determining the number of its strokes in a given time, so as to maintain a uniform pressure in the mains, or to prevent racing from any cause.

Punch.—1. To perforate with an instrument by pressure or percussion; as, to punch a hole.

2. A masons' hand tool, with a chisel edge about 1/4" wide, used with the hammer to remove superfluous stone in dressing large blocks.

3. A tool engraved to reproduce a design in cameo, as for type founding; the blow of the punch on softened metal makes a *matrix*, from which the desired type is cast.

4. A steel tool, used to form holes through thin sheets of metal, under blows from a hammer.

5. A similar tool pressed through heavier plates by power, in a bear or machine.

6. A similar tool employed by carpenters, etc., to drive nail heads below the surface of wood, etc.

Punched Holes.—In structural iron work, rivet holes are commonly punched in plates for boilers, bridge and girder work. Only in the best work are they drilled. The holes are either marked direct with compasses or from a *templet* and punched singly; the plates being moved by hand or in some cases automatically. The proper spacing out of punched holes is of the utmost importance, as preventing the injurious employment of the *drift*.

Punched Plates.—In structural iron work, plates of wrought iron and mild steel are suitable for punching; hard steel is unsuitable. Plates which will not stand punching are too brittle for boiler and girder work. Punching involves, under the most favorable circumstances, a loss of strength, due not only to the diminution of sectional area, but to straining the plates beyond their limit of elasticity, hence punched plates are sometimes annealed. Holes should be drilled in boiler work.

Puncheon.—1. In carpentry, a short, upright piece of timber used in framing; a short post; an intermediate stud.

2. A split log or heavy slab with the face smoothed; as, a floor made of *puncheons*; these are broad, flat pieces of timber riven from the central portion of a log and roughly dressed by axe or adze, so as to be used for flooring.

Punching.—The act or process of making holes by means of a punch. This method is expeditious, but is not allowed for important work, as the plates are very much distressed around the holes. The metal is caused to "flow" into that surrounding the holes, and it is necessary to remove this displaced material by subsequent reaming. Annealing will partially remove the strains set up, but in view of the cost of reaming and annealing, it is preferable to drill the holes at starting. Insurance companies and governments do not permit punched holes in boiler plates, and with the special drilling machinery now employed, the time occupied in drilling is but little more than that needed for punching.

Punching Bear.—A portable press, operated either by screw gear or a small hydraulic ram, for punching holes in erection or other field work.

Punching Machine.—A machine tool which drives a large punch, used in boiler shops, ship yards, etc. Such machines are sometimes belt driven, or have independent motors, hydraulic power being supplied for large ones. It is customary to fit the machine with a plate shears at the other end and an angle iron cutter in the middle, as well as the punching part.

Punch Pliers.—Pliers having a tubular, sharp edged steel punch attached to one of the jaws for perforating leather, paper, and the like.

Puncture.—1. A pricking or perforation with a pointed instrument.

2. Perforation of an inflated rubber automobile tire by contact with some sharp substance on the roadbed, etc.

Punning.—The operation of ramming down soil or other excavated or deposited material, in order to secure firmness and solidity.

Punty.—In glass making, an iron rod used by the artisans for manipulating the hot glass. Called also *pootee*.

Puppet Valves.—In machinery, a valve which moves vertically and is guided to and from its seat by a central vertical stem, coincident with the axis of the seat. Also called *poppet valves*.

Purchase.—1. To buy or acquire for money. Also to acquire by means of labor, struggle, or other means, save inheritance or bequest.

2. That which is bought or acquired by either of the above means.

3. A grip or firm hold of advantage secured in the raising or moving of cumbersome bodies.

4. A tackle reeved for any purpose of lifting or hauling, so as to gain power.

Pure Rubber.—A term applied to vulcanized india rubber which is homogeneous throughout to distinguish it from *insertion rubber*.

Purification of Water.—This may be effected in three ways: 1, by mechanical means, such as settling tanks, filters or weirs; 2, by chemical means, such as are used for water softening; 3, by bacteriological means, the action of bacteria having a great effect upon the purification of water.

Purifier.—1. That which purifies, cleanses or refines. In a flour mill, a machine or device for purifying or separating; as, a middlings *purifier*.

2. In gas manufacture, one of a series of chambers containing perforated trays or sieves in which are spread either moist slaked lime or hydrated ferric oxide. The gas passes through these materials either of which removes the gaseous impurities containing sulphur, the former removing carbon dioxide also. This forms calcium sulphide and calcium carbonate, the two materials making a useful by product, which is sold as a fertilizer.

Purlin.—A piece of timber laid horizontally upon the principal rafters of a roof.

Push.—1. To press against with force; to drive or impel by pressure; or to endeavor to drive by steady pressure without striking; opposed to draw.

2. Any pressure, impulse, or force applied; as, to give the ball the first push.

Push Button.—A button or knob which, on being pushed, opens or closes an electric circuit; as used in connection with bells, incandescent lamps, etc.

Push Car.—A truck for transporting stores, tools, etc., pushed by hand.

Push Fit.—One in which the corresponding male and female parts may be pushed together by hand, and may even be rotated for awhile, but heating is liable to be set up.

Putlog.—A squared scantling used to support the boards in a bricklayers' scaffolding. The putlog rests with one end in a hole in the wall and the other rests upon the *ledgers* or *runners*. In heavy stone masons' scaffolds, there are no putlog holes, an inner scaffold being put up to support the wall end of the putlogs.

Putlog Hole.—An aperture formed in a wall by the omission of a header brick. It serves to receive the putlog or transverse support of the scaffold boards.

Putty.—1. A cement used by painters and glaziers for stopping nail holes or defects in woodwork or iron before painting; for securing glass in window frames, etc. It is made of dry whiting (pure chalk ground and washed) mixed with raw linseed oil. Putty used in hot countries should have a little cottonseed oil added to retard the drying, and for glazing, requires the addition of ten per cent. white lead to increase its durability.

2. A cement used by engineers, made of red lead mixed with white lead and linseed oil: especially useful for joints between rough surfaces; as, on boiler mountings.

3. A thin mortar, having considerable water added to it, employed by plasterers.

4. A paste composed of lime and water, used by plasterers and builders.

Putty Joint.—A temporary plumbers' joint, made of red lead putty plastered around the joint, covered with a rag and bound with cord.

Putty Knife.—A knife or spatula with a diamond shaped edgeless blade, used by glaziers to spread putty in the grooves of window sashes, etc.

Putty Powder.—A preparation used for polishing silver plate, lenses, etc., in making white glass and in enameling, rendering the enamels opaque. It is prepared by roasting tin in air, or by heating any of its hydrates.

Pyramid.—A solid structure of masonry, usually of stone, generally with a square base and with triangular sides meeting in an apex; as, the Great Pyramid of Egypt. This structure was originally 481 feet high, and its base 756 feet square.

Pyrites.—A mineral, usually whitish or yellow with a bright luster; any one of the metallic sulphides; as, of iron or copper.

Pyro-engraving.—In engraving, a mode of ornamental engraving by a system of heated metallic cylinders, ending in points, which burn into the wood or leather any design required. Also called *pyrography*.

Pyrognostics.—In minerals, the characteristics of a mineral observed by the use of a blow pipe; as, to the degree of fusibility, flame coloration, etc.

Pyrometer.—An instrument for measuring degrees of heat above those indicated by the mercurial thermometer, constructed usually on the principle of registering, or measuring, by means of multiplying levers and a scale, the change in length of some expansible substance, as a metallic rod when exposed to the heat to be measured.

Pyrometry.—The measurement of temperatures above the range of the ordinary thermometer. The early forms, depending upon the expansion of bars of metal, porcelain or fireclay, give uncertain indications, which have led to their disuse. A useful approximate method for medium temperatures, as of chimney gases, consists in subjecting a weight of iron or copper to the heat it is desired to measure, and then quenching it in a known weight of water, the rise of temperature of the water, subject to certain corrections, giving the measure of the heat of the weight or ball.

Q.—The seventeenth letter of the English alphabet.

Quad.—1. A contraction of quadrangle, or interior rectangular court of a college, etc.

2. A contraction of *quadrat*, a blank type used in printing, for the larger blank spaces at the end of lines, made in four sizes for all text type, namely: En, em, 2 em, 3 em.

Quadrangle.—1. A geometric plane figure having four angles; a four square or quadrilateral figure.

2. The oblong or rectangular courtyard almost or quite surrounded by buildings, as commonly arranged in public buildings, such as colleges, courts, etc.

Quadrant.—1. The quarter of a circle or of its circumference; a sector, arc or angle of 90°.

2. An instrument for measuring the altitude of the sun, consisting of a graduated arc of 90°, with a movable radius for measuring angles on it.

3. In steam engineering, a sector shaped bar, over which the reversing lever slides. Notches in the quadrant receive the latch on the lever and hold it in any desired position, for regulating the admission of steam to the cylinders.

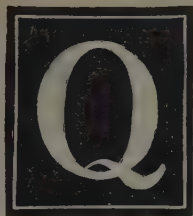
Quadrant Plate.—In machinery, the plate which carries the stud wheels in the change wheel series, for screw cutting in the lathe. It is hinged on the end of the leading screw and is provided with two parallel slits for carrying the stud or studs for the intermediate wheels. Being thus hinged, the studs with their wheels can be brought into almost any desired position, in relation to the wheels on the mandrel and on the guide screw.

Quadrant Tile.—In steam engineering, a firebrick tile formed into the quarter of a circle, as used for covering the shell side flues, etc., of boilers.

Quadratic.—Of or pertaining to a square, or to squares; resembling a square.

Quadratic Equation.—In mathematics, an expression of the condition of equality between two algebraic quantities or sets of quantities pertaining to a square.

Quadrilateral.—In geometry, a polygon having four sides and four angles.



Quadrisection.—To divide into four equal parts.

Quadruple.—Taken or multiplied four times; fourfold.

Quadruple Expansion.—In steam engineering, a four stage expansion engine, the steam being successively expanded in four cylinders, thus dividing the temperature range into four stages, and permitting of a higher degree of expansion, than in the triple expansion engine. Quadruple engines may be used to advantage, in marine practice, when the initial steam pressure is over 200 lbs. per sq. in.

Qualitative.—Relating to quality; having the character of quality.

Quality.—1. Distinguishing property, peculiar power or capacity, distinctive trait; as, the prime quality of the materials.

2. The degree of fineness or excellence of anything.

Quality Lever.—With internal combustion motors, a lever controlling the proportion of gasoline in the mixture made by the carburetor when the latter is of the surface or other non-compensating type.

Quantitative.—Relating to quantity; estimated according to quantity.

Quantity.—1. The property of being measurable, or capable of increase or decrease, multiplication or division; a sum or bulk; sometimes, a considerable amount; as, a quantity of lumber.

2. Quantities in algebra are expressed by letters, or by a combination of letters and figures; as, a, b, c, 2x, 5z, etc. The first letters of the alphabet are used to express known quantities; the last letters, those which are unknown.

Quantity Lever.—In an internal combustion motor, a lever whereby the amount of mixture, passing from a surface or other carburetor, is controlled; the amount of gasoline entering the carburetor being regulated by the *quality lever*.

Quarry.—A place, cavern or pit, but more usually open air workings where building stone, cement, rock, slate or similar

materials are dug out, or are separated by hewing and blasting from a large mass or bed of rock.

Quarrying Machine.—A sort of gang drill which may be inclined at various angles for cutting channels, grooves, etc., in the rock bed, so that masses of stone or blocks may be split off from it. The machine usually runs on rails along shelves or benches in the quarry, carrying its own boiler, or fed with steam or compressed air from suitable points.

Quartation.—In assaying, the process of separating gold from silver by means of nitric acid which demands, to be successful, that in the alloy, there shall be one part of gold to three of silver. The alloy is boiled in the nitric acid, which dissolves the silver, leaving the gold as a sponge. The silver is afterwards recovered as a chloride, by precipitation with a solution of common salt.

Quarter.—1. In arithmetic, one of four equal parts into which anything is or may be divided; a fourth part or portion.

2. In building, an upright scantling between posts, on which to nail partition laths; a stud.

3. In milling, a section of a millstone face, containing nearly a complete series of furrows.

4. The ship's sides towards the stern, where the bulwarks begin to curve in.

Quarter Bend.—In plumbing, a pipe bent to an angle of 90°.

Quarter Day.—The day that begins or ends, as the case may be, a quarter of a year; hence one of the four days in the year on which, by law or custom, moneys payable quarterly become due.

Quarter Deck.—A raised after portion of a ship; it differs from a poop in that it is an integral part of the ship's structure, while the latter is an erection on deck.

Quartered Oak.—Oak timber that has been *quarter sawn* so as to show the edge grain.

Quartering.—In mechanics, the act of setting at an angle of 90° or quarter of a circle; particularly applied to double headed machines that are so constructed as to bore the holes for crank pins in a pair of driving wheels at exactly right angles.

Quartering Belt.—In millwrighting, half crossed belting.

Quartering Machine.—A machine with two boring heads, set at an exact angle of 90°, whereby the bosses for crank pins are bored in locomotive driving wheels

or in the discs of stationary engines, securing the proper angle between the two cranks.

Quartermaster.—1. In navigation, an officer who attends to the helm, binnacle, signals, and the like, under the direction of the captain.

2. In military organization, an officer whose duty it is to provide quarters, provisions, storage, fuel, transportation, etc., for a regiment or other body of troops, and who has charge of all construction work for his department.

Quarter Sawed.—In woodworking, when a log is cut into slices by gang or circular saws, about a fourth of the planks (from near the center) will show the annual rings running across the end of the board, and the spring and summer wood lying in parallel lines on the face. These are sometimes picked out and sold as *quarter sawed wood*, but real *quarter-sawn* lumber is obtained by first cutting the log into quarters, and then sawing each portion into boards or scantlings at an angle of 45° with the diameter. Wood sawn in this way wears better, warps and shrinks less, and has a more handsome grain, and is therefore usually applied to oak and other hard woods, and also to pine for flooring boards.

Quarter Turn Drive.—In belting and shafting, a transmission of power by means of a quarter twist belt.

Quarter Twist Belt.—A method of driving two shafts at right angles to each other and in different planes. The pulleys must be set so that a plumb line from the center of the face of the upper pulley, on the side where the belt leaves it, will touch the center of the face of the lower pulley on the side where the belt leaves it. The direction of rotation must be such that the twisted belt is always "going on" to the upper pulley.

Quartz.—A hard crystalline rock of various colors, the common form of native silica. It is hard enough to scratch glass, and its specific gravity is 2.66 when pure. When colorless and crystallized it is known as *rock crystal*.

Quartzose.—Rocks consisting of quartz.

Quartz Pick.—In mining, a medium sized pick; it is double pointed, about twenty-four ins. long, and weighs from 3½ to 6 lbs. It is also known as a *drifting pick*, from the nature of its employment.

Quasi.—A word from the Latin, in common use, meaning, as if; as though; as it were; in a certain sense or degree; as, a *quasi* contract, an implied contract, etc.

Quaternions.—In mathematics, a science or calculus of fourfold quantities, applied in the higher mathematics to arrive

at the solution of difficult problems. A quaternion is a *fourfold* quantity.

Queen Post.—In building, one of two suspending posts in a roof truss, or other framed truss of similar form, situated either side of the ridge pole, a single vertical strut under the latter forming a *king post*.

Quench.—To extinguish; to overwhelm; to make an end of; said of flame and fire, or things burning.

Quenched.—In blacksmithing, when steel is heated for hardening or tempering, and then dipped into water or oil, it is said to be quenched.

Query.—A question; an inquiry to be answered or solved.

Question.—The act of asking; inquiry; as, to examine by *question* and answer.

Quick.—Done or occurring with celerity or in a short time; rapid; speedy; swift; as, a *quick* movement.

Quick Lime.—Lime burnt and unslaked; calcium oxide; prepared by burning limestone or marble in kilns to drive off the carbonic acid.

Quick Match.—A match wick, as of threads of cotton that burn quickly at the rate of about three inches to a second; used in connection with rock work, etc. Cotton wick is boiled in saltpetre and rain water for one hour, alcohol is added to the mixture while warm and is simmered for 15 minutes. Mealed powder is then added and the whole left for 24 hours. The cotton wick is wound on a reel and mealed powder sifted over it. It is then dried.

Quick Return Motion.—In mechanics, tools having a reciprocating motion, such as planers, shapers and slotters, are generally provided with gearing which makes the return or idle stroke several times as fast as the cutting stroke, the object being to minimize the waste time as much as possible.

Quicksand.—Sand easily moved or readily yielding to pressure; especially a deep mass of loose or moving sand mixed with water, and very dangerous from the difficulty of extracting a person who begins sinking into it.

Quicksilver.—The metal *mercury*; so called from its resemblance to liquid silver; is also so called on account of its fluidity at normal temperatures.

Quill.—1. A piece of small reed, or other hollow plant, on which weavers wind the thread which forms the woof of cloth.

2. The instrument with which musicians strike the strings of certain instruments; the tube of a musical instrument.

3. To plait, to form with small ridges like quilts or reeds; as, a woolen stuff *quilled*.

Quilting Frame.—A frame provided with adjustable bars, etc., to stretch fabrics out flat and tight for purposes of quilting or embroidering.

Quinine.—An important medicine extracted from Peruvian bark. Its salts are largely used in medicine on account of their tonic qualities, etc., especially in malarial affections of all kinds. The history of the discovery and introduction of this marvelous cure for malaria is very interesting.

Quintal.—One hundred lbs., or one hundred and twelve, according to the scale used.

Quintuplex Pump.—A geared mine pump having five rams or plungers, worked by cranks or eccentrics.

Quire.—A collection of twenty-four sheets of paper of the same size and quality unfolded, or having a single fold; one twentieth of a ream.

Quirk.—A small tool used by plasterers in working around mouldings and intricate work; it resembles a foundryman's *sleecker*, having a trowel, spoon, or square point at either end.

Quit.—To release from obligations; to discharge, as obligation or duty; to have done with; as, to *quit* work; to *quit* the place.

Quit Claim.—A release or relinquishment of a claim; a deed of release; an instrument by which some right or claim which one person has, or is supposed to have, against a person or property is given up without any warranty except against himself.

Quoins.—1. The external angles of a building, or the separate bricks or stone blocks of which the corners are made: when the latter project and are chamfered off at the edges, they are known as *rustic quoins*.

2. Wedge like pieces of wood, stone, metal, etc., used for many purposes; as, the *gunner's quoin*, or wooden wedge to support the breech of a cannon, and regulate its elevation; a *printer's quoin* or wooden wedge to secure the type in a chase or on a galley; also as used by masons to steady stones, or by sailors to chock up a cask on its bilge.

Quota.—A proportional part or share; or the share, part, or proportion assigned to each.

Quotation.—1. The act of quoting or citing.

2. That which is quoted or cited; a part of a book or writing named, repeated, or adduced as evidence or illustration.

3. The naming or publishing of the current price of bonds, or any commodity; also the price named.

4. In printing, a piece of hollow type metal, lower than type, and measuring two or more

pica ems in length and breadth, used in the blank spaces at the beginning and end of chapters, etc.

Quote.—In commerce, to give or mention a price for anything, whether in buying or in selling; to cite a rate cost, or price for any commodity, service, or work.

Quotient.—In arithmetic, a number which shows how often one number is contained in another.



R.—The eighteenth letter of the English alphabet. The three R's: a jocose expression for Reading. (w) Riting, and (a) Rithmetic; the fundamentals of an education.

Rabbet.—In carpentry, (1) to cut, as the edge of a board, in a grooved manner, so that it may form a joint with another board similarly cut; also, to cut a rectangular groove, or recess, longitudinally in the edge of; as, a board, timber, or the like, to receive a corresponding projection upon the edge of another board, etc., so as to form a joint; (2) to lap and unite the edges of, as boards, etc., by a rabbet.

Rabbet Joint.—In carpentry, a mode of joining wooden stuff, in which rabbets are made upon the contacting edges of the boards, so as to overlap each other.

Rabbet Plane.—A carpenters' plane, used to form the recesses or shoulders in rabbeting. The iron is the full width of the stock, which is made in thickness ranging from $\frac{1}{4}$ inch to 2 inches. If the cutter is set slightly inclined or *skew-mouth*, the plane works better than when it is set transversely or *square-mouth*.

Rabble.—A rake or hoe, used in working metals in a furnace; as, in puddling, or handling ore on a dressing floor.

Rabbling.—In puddling, the act or process of manipulating the plastic iron on the hearth of the puddling furnace, by means of a *rabble* or bar, the object being the combustion of carbon contained in the metal, and elimination of silicon and other impurities.

Rabbling Hole.—An opening in the wall of a puddling furnace, through which the rabble is introduced.

Race.—In hydraulics, a canal or water course, leading from a dam to a water wheel which it drives; sometimes called the head race, in opposition to the tail race, which is the water course leading from the bottom of a water wheel; a mill race.

Race Course.—In hydraulics, the canal along which water is conveyed to or from a mill wheel.

Racing of Engines.—Violent running away of machinery, when the load is suddenly removed. To prevent the damage which might arise from this cause, stationary engines are frequently fitted with a supplementary governor, which comes into play should the belt break or come off. Racing is especially noticeable with marine engines, during rough weather, whenever the propeller leaves the water, but owing to the steam entrained in the three or more successive cylinders, no governor is so effective as the engineer himself, he being able to anticipate the upward plunge and shut off steam before the engines race, which no mechanical governor can accomplish easily.

Rack.—1. A straight bar with teeth on its edge, meshing with those on a wheel or pinion, which is to drive or follow it.

2. In mining, the frame on which ores are separated or washed.

3. A strong frame of wood, having several sheaves through which passes the running rigging.

Rack and Pinion.—In mechanics, a bar with teeth on its face or edge, to work with those of a wheel pinion or worm, which is to drive it or be driven by it.

Rack Feed.—A feeding device for a machine tool, in which the table carrying the work is provided with a rack, which is driven by a gear wheel; the rest carrying the tool may be advanced along the work in similar manner.

Racking.—1. The running of the block carriage of a crane, or traveller, inwards or outwards, to adjust it to the requirements of the work.

2. The running of a slide rest along with rack and pinion gear.

Rack Lashing.—A lashing, where the rope is tightened and held fast by the use of a small stick of wood twisted around.

Rack Locomotive.—A locomotive fitted with cog wheel gearing, working in a rack between the rails, enabling it to haul trains over gradients insurmountable with ordinary adhesion. The boiler of the locomotive is pitched at such an angle that a uniform water level is maintained on a steep incline.

Rack Rail.—A third rail, having teeth on its face, with which cog wheels on the locomotive engage, to haul railway trains where the gradient is steeper than can be overcome by the adhesion of the driving wheels.

Rack Railway.—A railway rising at too steep an inclination for ordinary adhesion, and therefore having a rack laid between the rails, spur wheels on the locomotive gearing into this rack. The teeth of the rack and of the pinion are *staggered*: that is, portions of the same tooth are in advance of the rest, giving a more sure contact and a smoother one. As usually fitted, the locomotive has extra cylinders driving the cog wheels, power being applied to both gear and adhesion wheels in mounting a grade. The first and last length of rack at either end of a gradient is mounted on springs so that the locomotive shall engage with it without shock, it being usual to prolong the rack for some distance on to the more level portions. Mountain railways such as the Righi, work by rack alone, without adhesion; the steepest of all, Mt. Pilatus, has a gradient of 61 per cent., and has bevel wheels fitting into each side of a heavy toothed bar, unlike the other roads.

Rack Saw.—A saw having wide teeth.

Raddle.—In weaving, an instrument consisting of a wooden bar, with a row of upright pegs set in it, employed by domestic weavers to keep the warp of a proper width, and prevent it from becoming entangled.

Radial.—Extending from a center in the manner of rays; as, the spokes of a wheel are radial.

Radial Axle Box.—A pair of boxes for a carrying axle, capable of lateral motion in curved guides, and controlled by springs.

Radial Drill.—A drilling machine with an upright pillar from which projects a horizontal radial arm, which may be swung around the pillar; the vertical drill spindle is carried by the arm and can be run in or out on a slide, thus enabling the machine to take in a greater variety of sizes and shapes of work than a rigid drill press.

Radial Flow.—A turbine is said to have radial flow when the water flows inwardly from the circumference of the wheel to its center, or outwardly in the reverse direction.

Radial Paddle Wheel.—A paddle wheel in which the floats or buckets are rigidly fixed to the arms.

Radial Stay Boiler.—A locomotive boiler in which the fire box crown is

arched, and is stayed from the outer fire box by screwed stays pitched *radially* to the curvature of the two shells.

Radial Valve Gear.—In steam engineering, a mechanism of linked rods, moving in constrained arcs, used as a *reversing valve motion*.

Radian.—In mathematics, an arc equal in length to the radius of the circle of which it is a part; also the angle subtended by it; $57^{\circ} 17' 44.8''$ +.

Radiant Rays.—In physics, these are said to go in all directions, yet act in the most efficient manner when striking a surface exactly at a right angle to their line of movement. The sides of a fire box are for that reason not as efficient as the surface over the fire, and a flat surface over the fire is the best that can be had, so far as that fact alone is considered.

Radiate.—To send out in rays, as of light or heat from a point or surface; hence, to extend in all directions, as from a source or focus; to give forth rays.

Radiating Power.—In mechanics, a power proceeding in direct lines from a point or surface and producing heat.

Radiation.—The emission and diffusion of rays of light, and what are termed the rays of heat.

Radiation of Heat.—Throwing out of heat in rays; the opposite process of absorption. All bodies possess the property of radiating heat. The heat rays proceed in straight lines, and the intensity of the heat radiated from any one source becomes less as the distance from the source increases. This decrease is governed by a natural law, which is this: the intensity decreases in the inverse ratio of the square of the distance; for example, at any given distance from the source of radiation, the intensity of the radiant heat is four times as great as it is at twice the distance.

Radiator.—1. That which radiates or sends forth heat; as, by a coil of steam or hot water heating pipes. Specially, a series of pipes provided with fins or deep external ribs to give a large surface for interchange of temperature.

2. In a water cooled motor car, an arrangement for cooling the circulating water, by passing it through a reservoir of cells or ribbed tubes, which expose a great area to the air and thus cool the water by radiation.

Radiator Valve.—An angle globe valve, such as is fitted to steam heating radiators.

Radical.—In mathematics, pertaining to or forming the root of a number or quantity; especially the radical sign, used to

indicate that a root of the number to which it is prefixed is to be extracted.

Radicand.—A quantity or expression of which a root is to be extracted.

Radiometer.—An apparatus invented by Sir William Crookes which demonstrates the power of light. A set of metal vanes, blackened on one side and bright on the other, is fixed on a vertical axis, capable of free revolution, within a glass bulb from which the air is exhausted. Radiant heat received by the vanes causes them to rotate at a speed depending upon the intensity of the radiation.

Radium.—A metal allied to barium, found in minute quantities in a few rare uranium bearing minerals; notably, pitchblende. The metal itself has not been separated, but is obtained as a bromide, after most careful and laborious treatment at the rate of about one ounce to 140 tons of pitchblende. Radium is an element whose atom is unstable; that is, it spontaneously breaks up into simpler atoms, the decomposition being manifested as a shower or streams of infinitesimal corpuscles accompanied by the emission of relatively great amounts of energy. The rate of decomposition is such that a grain of radium would last 150 years.

Radius.—A straight line drawn from the center of a circle to any part of its circumference, all lines so drawn being equal in length; the semi-diameter of a circle.

Radius Bar.—In a locomotive, a heavy beam forming two sides of a triangle, its ends attached to the frame of a pony truck, while its apex is pivoted upon a pin fixed in a brace or *cross tie* in the central line of the engine.

Radius of Gyration.—In physics, the distance of the center of gyration of any figure from its axes of rotation. The center of gyration is that point at which, if all the moving matter were collected, it would obtain equal angular velocity from, and sustain equal resistance to, the force that gives the rotary motion. More plainly termed the center of inertia.

Radius Rod.—The intervening connection between the reversing links of radial valve gears, as the Joy or Walschaert type, and the valve stem, replacing the valve rod used with indirect valve gearing. A radius rod is also used with Gooch and Allan link motions.

Radix.—In mathematics, a number or quantity which is made the fundamental number of any system; a base. Thus, 10 is the *radix* or base of the decimal system of notation.

Raft.—A collection of boards, planks, pieces of timber, or the like, fastened together, either to serve as a support upon the water, or to move the materials from one place to another; a float.

Rafter.—A roof timber; a piece of timber that extends from the plate of a building to or toward the ridge, and serves to support the covering of the roof.

Rag.—1. A piece of cloth torn off; a tattered fragment, a bit.

2. In geology, a coarse kind of rock, somewhat cellular in texture.

3. In metal working, a ragged edge.

Rag Bolt.—An iron pin with barbs on its shank to retain it in its place.

Ragging.—In mining, the first process of separating ore from utterly worthless veinstone, generally carried on by hand-hammering and picking.

Rag Wheel.—A polishing wheel made of discs of cloth clamped together on a mandrel.

Rail.—1. In carpentry, a bar of timber, usually horizontal or nearly so, extending from one post or support to another; as, in fences, balustrades, staircases, etc.

2. In architecture, a horizontal piece in a frame or paneling.

3. In civil engineering, a bar of steel or iron, forming part of the track on which car wheels roll.

4. In navigation, the stout, narrow plank that forms the top of the bulwarks; the light fence like structures of wood or metal at the break of the deck, and elsewhere, where such protection is needed.

Rail Bond.—In civil engineering, the connecting of rails in such a manner that the joints are so placed that the whole line makes one entire *bond*.

Rail Chair.—A chair or pedestal resting upon the tie or sleeper, having jaws for the reception of the rail which is secured therein by a key or wedge. The chair is necessary for rails which have two heads, and is therefore used everywhere where the flat bottomed rail is not employed.

Rail Gauge.—In railway engineering, an iron bar having a projection or offset near each end at right angles with the bar, the distance of whose outer faces apart is that of the gauge of the rails, which are laid down by direct measurement therefrom.

Railing.—1. In carpentry, a series of rails, as in a fence or barrier; a continuous rail with the upright structure supporting it; a fencing or protection.

2. Rails or material for rails.

Rail Joint.—A splice connecting the ends of rails.

Rail Mill.—A steel works where rails are produced; a rolling mill devoted to the production of rail sections.

Railroad.—1. A graded road on which iron or steel rails are laid, supported by sleepers, and designed for the passage of rolling stock.

2. The whole system of tracks, stations and machinery used in transportation by rail.

Railroad Barrow.—A wheelbarrow used about railroad shops and on construction work.

Railroad Duster.—In paper making, a continuous series of machines, in which the rags are torn to pieces by revolving cylinders armed with teeth, while the dust and dirt fall through gratings at the bottom; the material passing from cylinder to cylinder until clean.

Railroad Tie.—In civil engineering, a piece of timber laid across the track and held down by ballasting, serving also to retain in place the rails, which are spiked to the ties.

Rail Saw.—A saw used in rail rolling mills for cutting off the *crop ends* of rails after they leave the rolls.

Rail Straightener.—In railway engineering, a powerful screw press used for straightening or bending rails and bars. Some of these machines are worked by a hand lever, or a wheel, actuating the screw, some by hydraulic pressure. The rail is sustained on two points at some distance apart and the pressure is applied between these points. Also called *rail bender*.

Railway Head.—In cotton manufacture, a lapping machine which unites the product of a large number of carding machines, which has been collected by a traveler under the various doffers known as the "railway;" the railway head thus amalgamates 60 to 100 slivers into one broad lap, for the finishing card.

Railway Plant.—The tools, machinery, locomotives, cars, etc., for building and working railways.

Railway Signals.—Fixed devices whereby intimation is given to engineers that the line is clear, or the reverse, for the passage of a train. The most usual types consist of various arrangements of semaphore arms combined with different colored lights, a dropped arm or green light signifying "line clear," a horizontal arm and a red light denoting "line blocked" or danger. Square or circular targets revolving about an axis are occasionally employed for special purposes.

Raiment.—Clothing in general; garments.

Rain.—Water falling in drops from the atmosphere; the descent of water in drops from the atmosphere. Rain is distinguished from mist by the size of the drops, which are distinctly visible. When water falls in very small drops or particles, it is called mist; and fog is composed of particles so fine as to be not only indistinguishable, but to float or be suspended in the air.

Rainfall.—1. A fall or descent of rain; a shower.

2. The quantity of rain falling in a certain time within a given locality; usually estimated as a depth of so many inches. This represents the level to which the ground would be flooded supposing no water were absorbed, evaporated, or ran away.

Rain Gauge.—An instrument for measuring the quantity of rain that falls at any place in a given time. The rain falls into a funnel shaped receiver of exact dimensions, and is led into a collecting tube of smaller dimensions, frequently one tenth the area of the funnel. This magnifies the apparent rainfall tenfold, permitting very exact observations to be made. An overflow attachment is provided occasionally to measure snowfall.

Raise.—To cause to rise; to bring from a lower to a higher place; to lift upward; to elevate; to heave; as, to raise a stone or weight.

Raise and Fall Slide Rest.—A device used on small lathes for delicate work which requires constant adjustment of the height of the cutting tool. The upper part of the slide rest is hinged at one end to the carriage, and the height may be quickly adjusted by means of a hand screw at the other end.

Raising Hammer.—A hammer with a long head, and a rounded pene, for beating out sheet metal into the form of a bowl or cup.

Rake.—1. In mining, a number of thin seams of ironstone lying so closely together that they can all be worked at once.

2. An instrument consisting of a head piece in which teeth are inserted, and a long handle at right angles to it; used for collecting hay

or other light things which are spread over a large surface, or for breaking and smoothing the earth.

3. The projection of the upper parts of a ship, at the height of the stem and stern, beyond the extremities of the keel.

4. The inclination of a mast from a perpendicular direction.

Rake Miter.—A miter between two mouldings, the profile of one of which has to be modified in order that the joint may be made.

Raking Moulding.—In metal work, a term used for the mouldings which are inclined; as, in a gable or pediment.

Raking Out.—In a foundry, the removal of the residuary coke, slag and metal, from the bottom of a furnace cupola, after the running down of the charge. This is done after every blowing and is necessary, otherwise the semi-fused mass would form a hard agglomeration when cold, the forcible removal of which would damage the furnace.

Raking Shore.—In erecting, a shore at an acute angle, running directly from the wall which it supports to the sole piece on the ground. An inclined support which is braced against another wall is known as a *raking strut*; a shore which does not go directly to the ground, but bears upon another, is termed a *rider*.

Ram.—1. The piston of a hydraulic press.

2. A machine for raising water by means of the momentary or moving force of the water, of which a part is to be raised, called also *hydraulic ram*.

3. A displacement plunger in force pumps.

Rammer.—In founding, a hand tool used to compress the sand in the mould by blows; it is generally double ended, the pointed or wedge shaped end being termed the *pene*, and the flat end, the *butt*.

Ramp.—1. A slope, such as the inclined end of a railway platform. A slope that is not *stepped*, but gradual. It is put in the English law that the ends of railway station platforms "must be ramped and not stepped."

2. A re-railing device, consisting of an angle rail or frog, one member slipping over the rail while the wheels of the derailed vehicle are levered on to the other leg and worked back on to the rail.

3. A short bend or slope where the hand rail or cap in stairways changes its direction.

Ramsay, David.—Died 1653 (?). An English mechanician and inventor, appointed clock maker to James I and Charles I.

Some watches of his make are still to be seen in London museums. By his inventive genius he obtained eight patents (1618-33), relating to plowing, fertilizing, raising water by fire, propelling ships, refining copper, dyeing, brick-making, smelting, etc.

Ramsbottom Ring.—A snap or spring piston ring, which is sprung into a groove on the piston body. So called from its inventor, Sir John Ramsbottom, who also devised the system whereby a locomotive picks up water while in motion, from a trough between the rails. Ramsbottom rings are turned from a cylinder of brass, cast iron, etc., larger in diameter than the piston, and enough cut from the side of the circle, to permit them to be compressed to the proper size.

Ram's Horn.—In rigging, a symmetrically shaped, double crane hook. Used chiefly for light weights, being inferior in strength to the single hook.

Ranch.—A tract of land used for grazing and the rearing of horses, cattle and sheep.

Random Rubble.—Rubble masonry in which all the joints are irregular, no courses being laid.

Random Tooled.—Masonry is said to be random tooled, when the marks of the dressing implements run irregularly, without definite direction.

Range.—A self-contained stove or fire-place, having one or more ovens, a hot water boiler, and several openings for carrying on various culinary operations at once.

Range Finder.—An instrument for ascertaining the distance of an object, usually by observation of the angle subtended by a known height. The instrument or a modification is used in surveying, for the measurement of inaccessible base lines, etc.; also for gunning purposes.

Ranging.—In civil engineering and surveying, the operation of laying out a line, along which a road, railway, canal or other public work is to be run.

Ranging Staff.—In surveying, a straight rod or pole, colored so as to be easily distinguishable, used for marking any desired point in *ranging*. Also known as *ranging rod*.

Rankine, William John Macquorn.—Born 1820, died 1872. A Scottish civil engineer. He made many important

contributions to the science of railway engineering, but after 1848 devoted himself exclusively to a series of researches on molecular physics, whereby he earned his chief distinction. In 1858, he was elected President of the Scottish Institution of Engineers.

Rapid.—Very swift or quick; moving with celerity; fast; as, a rapid motion.

Rapper.—In mining, a signaling apparatus, to notify the banksman when to draw up from the shaft, generally a lever causing a hammer to strike or rap on a plate.

Rapper Plate.—In moulding, an iron or brass plate countersunk into the wooden pattern, so that it may not be damaged by rapping.

Rapping.—In moulding, loosening the pattern from the sand of the mould by smart blows or raps struck on the sides of a bar, inserted vertically into holes in the pattern.

Rapping Hole.—In a foundry, a hole made in patterns, for the insertion of the loosening bar used in rapping. When a single moulding, or two or three mouldings only from a pattern are required, the rapping hole is usually bored in the wood of the pattern, but when a large number are wanted, *rapping plates* are used to prevent damage to the pattern. In large patterns several rapping holes are provided.

Rapping Mallet.—In a foundry, a small round faced wooden mallet, used for loosening the sand from patterns during the process of their withdrawal from the moulds. The faces and edges of the patterns are lightly tapped with the mallets as the pattern is gradually lifted. They are made of wood, as inflicting less injury to the pattern than iron hammers.

Rarefaction.—The act or process of rarefying; that is, making less dense, as with a gas or vapor; increase of the interstices between the particles of matter, so that each occupies a larger space.

Rasp.—A file that has coarse, single teeth, made by straight cuts of a pointed chisel, either cut or crossed.

Rasure.—The act of raising, scraping or erasing; erasure; obliteration.

Ratchet Bar.—In machinery, a straight bar serrated with teeth, like those of a ratchet wheel, to receive the thrust of a pawl. The use of the ratchet bar is to permit of movement in the one direction, while preventing it in the direction opposite.

Ratchet Brace.—In carpentry, a tool used for the boring of holes by hand. It consists of a curved lever, which moves the drill around. The lever is provided with a ratchet, so that if full turns cannot be made, the ratchet can be used for feeding.

Ratchet Brake.—A handwheel brake, having a ratchet and pawl to hold it in position, when applied or released.

Ratchet Drill.—A drill attached to a ratchet, so as to be revolved by the reciprocating motion of a hand lever; called also *pawl wrench* and *ratchet brace*.

Ratchet Jack.—In house moving and shoring, a *screw jack* rotated by means of a ratchet and click.

Ratchet Pawl.—In machinery, a pawl or click, which engages with the teeth of a ratchet or a spur wheel, as distinguished from the pawls used in sliding shafts of cranes and on turntables.

Ratchet Sprag.—A ratchet around the axle of a motor car, into which a pawl may be dropped for preventing backward motion of the vehicle on a steep hill, when power is off.

Ratchet Teeth.—In machinery, the teeth of ratchet wheels are differently formed, according to the use which they have to fulfill. When the ratchet pawl has to work in opposite directions at pleasure, as when moving a feed screw to right or left alternately, the teeth are like those of ordinary spur wheels, but when the motion is always in one direction only, their outline then, is roughly, though not quite, that of a *right angled triangle*.

Ratchet Valve Gear.—In automobiles, a device for operating the admission or exhaust valves of a gas engine, without the interposition of gearing or of a cam shaft. A push rod is driven by an eccentric on the crank shaft; this push rod is provided with a claw which engages the teeth of a ratchet wheel and freely rotating under the joint, between the valve stem and the push rod. The teeth of the ratchet wheel are alternately deep and shallow; when the claw rides in the shallow notch it is clear of the valve stem, but, falling into the deep notch on the next stroke, makes the connection, thus opening the valve at each alternate revolution.

Ratchet Wheel.—In machinery, a wheel provided with teeth into which a pawl fits. The pawl either moves and turns the ratchet wheel with an intermittent motion, which renders it capable of feeding a machine cutter, or the wheel

moves, its motion being independent of that of the pawl.

Rate.—1. To value at a certain rate; to estimate.

2. That which is established; as, a measure; price fixed with relation to a standard.

Ratio.—In arithmetic, the relation of two magnitudes or quantities, of one and the same kind; as, the relation of 5 to 10 or 8 to 16. The terms of a ratio are the two numbers compared. The *antecedent* is the first term of the ratio, and the *consequent* is the second term, and the two terms together are called a *couplet*. An inverse ratio is the ratio formed by inverting the terms of a given ratio. Thus, 8:9 is the inverse of 9:8.

Ration.—A fixed daily allowance of provisions; as, for a sailor or soldier, for his subsistence.

Ratio of Expansion.—The ratio existing between the final and the initial volumes of the steam in a cylinder or series of cylinders. If steam be cut off at $\frac{1}{4}$ of the stroke the ratio of expansion is 6 to 1, or 6. It is the reciprocal of the cut off.

Rat Tail File.—In machinist work, a file, circular in section, and tapering or bellied in the direction of its length.

Rattan.—One of the long slender flexible stems of several species of palms, growing in Africa, Asia and Australia. They are exceedingly tough, and are used for many purposes.

Rattle Barrel.—In a foundry, a barrel provided with many holes in the sides and suspended or resting on wheels which make the barrel revolve, thus shaking its contents of iron castings and clearing them of dust, and also causing by the continuous friction, the castings to lose their extreme roughness, and then to fall out of the barrel. Called *rattle barrel* on account of the sound it makes when in motion.

Rattler.—A tumbling box; a drum in which small castings are cleaned from sand, sprues, etc., by being rotated with pieces of slag, etc. Also called *rattle barrel*.

Rattle Trap.—Any machine or vehicle that does not run smoothly.

Ravel.—To separate or undo the texture of; to take apart; to untwist.

Rawhide.—Untanned skins of cattle, used when twisted to form whips, ropes, etc., being very hard and tough when dried.

The same material is also assembled in several thicknesses, compressed sidewise between iron cheeks and then cut to form gear wheels and pinions.

Rawhide Belting.—In millwrighting, belting which has not been subjected to the process of tanning, *except on the surface*.

Rawhide Gears.—In millwrighting, pinions and wheels made of hard leather built up in several thicknesses, through which the teeth are cut. They are used to a considerable extent for high speed driving, especially as a first gear of an electric motor; being durable, elastic and noiseless.

Rawhide Maul.—A round headed mallet, shaped not unlike that used by a mason, the head being composed of rawhide discs held tightly together by means of a nut.

Rawhide Pinion.—A small gear wheel made of several layers of compressed untanned rawhide.

Raw Material.—Crude natural products; substances requiring manufacturing processes to utilize them; material partly treated to fit it for further processes; thus, iron ore is the raw material of pig iron, while pig iron is again raw material for wrought iron or castings.

Raw Oil.—Unboiled linseed oil; the pure oil from the presses without admixture of litharge or other "dryers" It is used for work with white or light colored paints or for outside work.

Raw Silk.—The threads wound off from cocoons of the silk worm, after they have been placed in hot water to soften the natural gum that surrounds them.

Ray.—1. A beam of light thrown by a luminous body; light emitted in a given direction from any source.

2. The line along which light travels, or more specially, the line or direction of radiant energy.

3. A line along which the disturbance produced by any form of wave motion travels.

Razor Temper.—A very hard temper of crucible steel, containing $1\frac{1}{2}$ per cent. of carbon. The steel is very hard, and requires great care in working in the fire. It takes a fine, keen edge.

Reach.—1. To stretch out; as, the hand.

2. A pole or bar connecting the rear axle truck or runners, as of a vehicle,

with the bolster or some part of the forward end. Also called the *perch* or *reach rod*.

3. The sailing, or the distance sailed by a vessel on one tack.

Reaction.—Any action in resisting any other action or force; movement in a contrary direction, reverse action. In physics, reverse or return action; the equal and opposite force exerted on a body by the body acted upon; a force acting in opposition to or balancing another force or system of forces, hence, the philosophical truism 'action and reaction are equal, but in opposite directions.'

Reaction Turbine.—In hydraulics, a turbine in which the pressure or head of the water is employed, rather than its velocity or impulse. The current is deflected upon the wheel, by the action of suitably disposed guide blades, the passages being full of water. Rotary motion is obtained by the change in the direction and momentum of the fluid.

Reaction Wheel.—In hydraulics, an enclosed wheel into which water enters under head or pressure and escapes from it tangentially, the force being derived from the reaction of the weight thrown off at the edge of the wheel.

Read, Nathan.—Born 1759, died 1849. An American engineer and inventor. He invented (1788) a mechanically propelled boat which was followed by experiments with the steam engine for boat propulsion, resulting in the invention (1789) of the vertical multitubular fire box boiler by which steam at considerable pressure was obtained, and which led to ultimate success on the part of Fulton in the "Clermont;" he also invented a machine for cutting and heading nails in one operation, a threshing machine, a pumping machine, a method of equalizing the force of windmills, and other valuable labor saving devices.

Reagent.—A chemical that reacts upon a compound; a substance used to effect chemical changes upon a compound for discovering its constituent parts and determining its percentage composition; thus, iodine added to a solution containing starch turns it a beautiful blue, and on adding common salt to a gold and silver alloy, dissolved in nitric acid, the silver is at once precipitated as chloride and its quantity readily ascertained.

Reagent for Ammonia.—In refrigeration, known as Nessler's reagent, a solution of potassium iodide and hydrate with mercuric chloride, a few drops of which added to a few ounces of water turns it yellow if ammonia be present at all, and to a deep brown if there be any quantity. This test is so sensitive that it will detect one part of ammonia in 20,000,000 parts of water.

Ream.—1. Twenty quires of paper; properly 480 sheets.

2. To remove, clear away, empty. To enlarge a hole in metal with a rotary tool; in modern usage, to enlarge or dress out; as, a hole.

Reamer.—In machinery, a tool used to enlarge a hole and bring it to a shape the counterpart of the tool, whether cylindrical or tapering. It is fluted and slightly tapering, the blades being worked out of the solid metal by planing or milling on a machine. The flutes are then backed off like a tap to give a good cutting edge.

Reaper.—An agricultural machine for cutting grain crops; from the side of a two wheeled carriage protrudes a long bar armed with fixed knives termed *fingers*, while a *knife* or *scythe* consisting of triangular sections mounted on a bar, working between the slots of the fingers, and actuated by gearing from the wheels of the machine, forms a series of shears to sever the stalks of grain.

Reaper File.—A file, seven to ten inches long, slightly tapering, with a trapezoidal section and two safe edges; much used to sharpen the knives of reaping and mowing machines.

Reaping Machine.—A machine worked by horses or power, used for cutting and gathering different crops.

Rear.—1. The back or hinder part of any thing.

2. To lift up or elevate; to set up or erect in a lofty way.

Rear Drive.—Said of a cycle when the hinder is the driving wheel, as is usually the case.

Rear Sprocket.—The sprocket wheel on the rear or driving wheel of a cycle.

Reaumur Thermometer.—An instrument used in Russia, Sweden, Turkey and Egypt in which 0° corresponds to melting ice, and 80° to boiling water. From the freezing to the boiling point there are 80°. Reaumur is changed into Fahrenheit by multiplying by $\frac{9}{5}$ and adding 32° to the product.

Rebate.—1. A deduction from a bill or account; a drawback; discount.

2. A variety of freestone.

Rebate Joint.—In millwrighting, a joint which is made by the overlapping of the edges of material, half the thickness of the material being cut away to a little distance inwards from the matching edges.

Reboring.—In steam engineering, when engine cylinders have become grooved and of varying diameters through long use and wear, it is customary to bore them again and insert a larger piston. The process is termed *reboring*. Small cylinders are removed from their beds or foundations for the purpose, but large cylinders are rebored while in place.

Rebound.—To spring back; to start back; to be driven back by elastic force on collision with another body.

Recalescence.—In steel making, re-glow; the state of glowing again. On bringing a piece of iron to a white heat and letting it cool in a dark room, it will cool regularly, the colors fading to a dull red as the temperature falls. When a certain point is reached, about 1000° F., not only is the rate of cooling retarded, but the iron bursts out into a glow as if reheated, before fading again. This recalescence is occasioned by molecular changes in the metal, as iron is magnetic *below* the point of recalescence, non magnetic *above* that point. Also, iron is composed of alpha ferrite at a temperature below this critical point, while it becomes beta ferrite, a much harder modification, at a white heat, and remains so until, in cooling, the point of recalescence is reached.

Recarburization.—In steel manufacture, the adding of a definite amount of carbon to iron which has been first completely decarburized. Steel of various grades is thus made in the Bessemer converter, and in the cementation process.

Recast.—To mould anew; to cast anew; as, to recast an engine cylinder.

Recede.—To move back; to retreat; to withdraw.

Receipt.—1. A writing acknowledging the taking of money or goods; acknowledgment of payment.

2. That which is received; that which comes in, in distinction from what is expended, paid out, and the like.

Receive.—To take; as, something that is offered, given, committed, sent, paid, or the like; to give reception to; to accept; not to reject, repel, or turn away.

Receiver.—1. A person appointed, ordinarily by a court of chancery, to receive and hold in trust money or other property which is the subject of litigation, pending the suit; a person appointed to take charge of the estate and effects of a corporation, and to do other acts necessary to winding up its affairs, in certain cases.

2. A chamber between the cylinders of compound engines into which the steam from the high pressure cylinder escapes, and from which it is admitted to the low pressure cylinder.

3. A chamber in connection with an air pump, from which the fluid may be exhausted for the purpose of physical experiments.

Receptacle.—That which receives, or into which anything is received and held; a receiver or holder; a reservoir.

Recess.—1. A place made in a room by the setting back of a wall.

2. A niche or hollowed place made in anything; a place cut out.

Rechucking.—In machinist work, in all but the very plainest turned work it is necessary that it should be set a second or a third time in the lathe chuck or chucks, in order to turn some portions which could not be reached by the tool in the first chucking. This is termed *rechucking* or second chucking.

Recipe.—A formulary or prescription for making some combination or mixture of materials, especially a doctor's prescription.

Reciprocal.—The reciprocal of a number is another number which will give similar arithmetical results by the converse process; as, dividing by 0.25 is the same as multiplying by 4, or dividing by 4 is equivalent to multiplication by 0.25, therefore 4 and 0.25 are *reciprocals* of each other. Hence the reciprocal of a number is one divided by the number.

Reciprocating.—Having a to and fro motion; moving backwards and forwards, as distinguished from a circular motion.

Reciprocating Motion.—In mechanics, the act, process or state of changing place or position alternately forward and backward.

Reciprocating Parts.—Those parts of an engine having rectilinear motion, as the piston, piston rod and crosshead. For counterbalancing purposes it is customary to regard a portion of the connecting rod as reciprocating, usually one half, the remainder being accounted as revolving with the crank pin.

Reciprocating Pump.—A piston, plunger or bucket pump, as distinguished from a centrifugal or rotary pump.

Reciprocating Steam Engine.—One in which the power is created by the pressure of steam on a piston, moving it to and fro within a cylinder, the reciprocating motion being transformed into rotary by intervention of the crank and connecting rod, or *Scotch yoke*.

Record.—An authentic copy of any writing, or an account or memorial of any facts and proceedings, entered in a book for preservation; a register.

Recording Thermometer.—A metallic thermometer in which the expansion or contraction, due to heat, actuates an arm carrying a pen, which traces a line corresponding to the fluctuations of the temperature, upon a specially ruled roll of paper driven by clock work.

Records.—Formal writings of events or proceedings; books giving such an account.

Rectangle.—In geometry, a parallelogram having its angles right angles.

Rectified Spirits.—Alcohol which has been raised to the strength of 90 per cent. alcohol with 10 per cent. of water, by means of repeated distillation.

Rectifier.—In refrigeration, by the absorption process, a further portion of the analyzer, where on cooling the ammonia, gas water vapor is condensed and drawn off by a trap or drain cock, thus rendering the ammonia anhydrous. Occasionally the grated vessel known as the *analyzer* is termed the rectifier.

Recurring Decimal.—A decimal fraction in which, after a certain point, the digits are continually repeated. If there be but one recurring figure as 0.33333, the expression is called a *repeating decimal*. If a small group of figures repeat; as, 0.0368368, it is a *circulating decimal*. For sake of brevity these figures are written 0. $\dot{3}$ and 0. $\dot{0368}$, the dots showing the repeating period.

Re-cut File.—A file having new teeth cut, after the original teeth have been ground off.

Red.—A bright color, resembling blood, or the color furthest from violet in the spectrum or rainbow.

Red Brass.—In metals, an alloy variously composed; as, (a) copper, 24 lbs.; zinc, 5 lbs.; bismuth, 1 oz.; (b) copper, 24 lbs.; zinc, 5 lbs.; lead, 8 oz.; (c) copper, 32 lbs.; zinc, 10 lbs.; lead, 1 lb.; (d) copper, 160 lbs.; zinc, 50 lbs.; lead, 10 lbs.; antimony, 44 oz.

Red Brick.—Brick owes its color to the presence of iron in the clay from which

it is formed, although the color is modified by the presence of carbonates of lime and magnesia. As a general rule, 5 or 6 per cent. of ferric oxide (oxide of iron), will give a deep red to brick, and the color will deepen with a higher percentage.

Red Core.—In ice making, a reddish discoloration of the center of ice blocks, due either to rust in the system of piping or to iron oxides in the water.

Reddle.—A shop term for red lead, mixed with oil and used when filing and scraping metallic surfaces.

Red Fire.—A compound which burns with a red flame, used in pyrotechnic works, and consisting of nitrate of strontia, chlorate of potash, sulphur and antimony.

Red Heat.—In blacksmithing, there are several grades of red heat, distinguished by the prefixes, black, bright, or low red; the distinguishing of these shades of color being of importance in the hardening, tempering, and welding of iron.

Red Hot.—Red with heat; heated to redness; as, red hot iron.

Red Lead.—On passing an air blast over the surface of molten metallic lead, the metal absorbs oxygen from the air and is converted into *litharge*. This oxide is ground into a fine powder and reheated a second time, when it absorbs more oxygen, becoming, when cool, a bright scarlet or orange powder, known as *red lead*. It has a powerful drying action on oil, possesses good covering properties as a paint and may be mixed with other colors.

Red Marking.—A mixture used to put on a piece of machine work when trying its fit, and serving to denote the fit. It consists of a mixture of Venetian red and common oil.

Redressing.—In flour milling, the further processes of sifting and bolting the coarse articles of ground meal, by means of which all the flour is extracted from the "offals."

Red Short.—Iron or steel that is brittle or short when at a red heat; caused by an excess of sulphur in the iron.

Red Silver.—An ore of silver, of a ruby red or reddish black color. There are two species: the dark red contains 59% of silver united to sulphur and antimony, and the light red 65% combined with sulphur and arsenic.

Reduce.—1. In arithmetic, to change, as numbers, from one denomination to another without altering their value, or from one denomination into others of the same value, as, to reduce a dollar to a hundred cents, or a hundred cents to a dollar.

2. To separate; as, a metal, from other substances with which it is combined.

Reducer.—In steam and gas pipe work, a short fitting having female threads at both ends, one end being of smaller diameter than the other. It is used to connect pipes of unequal sizes.

Reducing Furnace.—In smelting, any furnace in which metals are separated from their ores and reduced to the metallic state. Hence, blast and some reverberatory furnaces are reducing furnaces.

Reducing Mill.—In vegetable oil manufacture, a machine for grinding up the edges of the oil cake, cut off by the paring machine. These rough edges formed around the cake during pressing, contain much oil and are ground up so that they may be heated afresh in the kettle and repressed.

Reducing Pulley.—An important adjunct of the indicator. Two pulleys are mounted upon the same axis, their diameters bearing to one another, the proper proportions between the stroke of the engine and the length of the indicator diagram; the angle through which the larger pulley is rotated, by means of a cord passed around it, from the crosshead of the engine, is transmitted by the smaller through a similar cord to the indicator drum.

Reducing Valve.—A spring or lever loaded valve, similar to a safety valve, whereby steam is maintained at a lower pressure within a pipe, than in the boiler which supplies it. Supposing the valve to be set at 60 lbs. pressure, it remains open until the pressure in the pipe shall have risen to that figure, when it closes, opening again as soon as the pressure begins to diminish and closing as it rises towards the upper limit.

Reduction.—1. The act or process of diminution in size, magnitude, quality or denomination.

2. The arithmetical process of bringing anything from a higher denomination to a lower, or the reverse, without altering its value; as, reduction of tons to pounds, or cents to dollars.

3. In physics, the reverse of oxidation; as, ores are reduced by the removal of the oxygen which they contain.

Reduction Ascending.—Changing lower denominations to higher; as, cents to dollars. The opposite of *reduction descending*; as, tons to pounds.

Reduction Descending.—In arithmetic, the operation of changing numbers of a higher into others of a lower denomination; as, dollars to cents.

Reduction of Area.—In mechanics, malleable iron and steel, when subjected to tensile stress, elongates up to the breaking strain, with a consequent reduction of area. The amount of elongation and reduction of area which it undergoes is a recognized test of its quality. The amount of reduction of area should not be less than twenty five per cent. in a good specimen, and the amount of elongation fifteen per cent.

Reduction of Temper.—1. The process of tempering steel which has been already hardened, by gradually heating it to a desired point and then quenching it a second time, the correct temper being usually judged by colors observed on polished portions of the tool.

2. Softening of a steel tool by overheating it while in use.

Reduplication.—In mechanics, reduplication refers to the gain in power obtained, by the combination of pulleys in pulley blocks. In a system of pulleys, a force equal to the pull of the rope comes into play at every departure of the rope from a pulley.

Redwood.—A mammoth tree found in California, sometimes reaching a height of 300 feet or more. The timber is of orange to red color, is soft and easily worked, but not very strong, is straight grained and therefore easily split; it resists the decaying action of soil. It is used for buildings and general purposes in California; elsewhere for furniture.

Red Zinc Oil.—In metals, an ore of zinc, of small commercial value. It occurs as an oxide, the red color being due to contamination with the oxide of iron and manganese.

Reed.—In weaving, a frame of parallel flat strips of wood, through which the warp threads pass, set in the lathe or batten.

Reef.—1. In mining, the same as lode or ledge; generally applied to gold bearing quartz, and of Australian origin.

2. To roll or fold up a portion of a sail, thus exposing less surface to the wind.

Reef Knot.—A knot formed by passing the ends of two parts of one rope through a loop formed by another rope, whose

ends pass similarly through a loop formed in the first; the parts of one being passed *over* and those of the other passed *under* the loop through which they are inserted. A straight pull tightens the knot, which can only be loosened by pushing the loops in opposite directions.

Reeking.—The coating over the faces of ingot moulds, for the casting of crucible steel, with a layer of carbon to prevent the adhesion of the ingot to the mould.

Reel.—1. A frame turning on an axis for winding rope, cord, yarn, fiber or other flexible substances; such as, a hose or a fishing net.

2. A millers' reel for bolting flour.

3. A winch.

Reeming Iron.—An iron chisel, used to open the seams of planks in calking ships.

Re-enforce.—To strengthen with new force, assistance, or support.

Re-engage.—To engage again; to enlist a second time.

Re-entering.—1. In calico printing, the process of applying additional colors by applications of printing blocks, to patterns already colored.

2. In engraving, the deepening of lines by a graver, either in repairing a plate or for perfecting an etching.

3. In structural iron work, the connection of two members on an angle, in one of which a plate enters in or between the other.

Re-entering Angle.—In geometry, an angle of a polygon pointing inward.

Re-evaporation.—In steam engineering, a term used to express the influence of an unjacketed engine cylinder in which steam is worked expansively. The cylinder being subject to the extremes of temperature of the entering and exhausting steam, the former is subject to *initial condensation* on its first entrance. The heat thus lost is, however, re-imparted to it, as it acquires by expansion a temperature below that of the cylinder, while towards the end of its work it acquires from the cylinder, hotter than itself, a vaporous condition, or is re-evaporated. By the use of the steam-jacket, these variations are prevented or minimized.

Reference Letters.—Characters placed upon various parts of a drawing or diagram, referring to an explanation elsewhere, in order to avoid crowding the drawing or picture with writing or letter press.

Refine.—To reduce into a fine, unmixed or pure state; to reduce; as, metals from the ore, to free from dross; to bring into an uncompounded state.

Refined Iron.—A wrought iron, which is produced by melting pig in a furnace in connection with a powerful air blast. The pig as it melts is raked into a mass with charcoal opposite the tuyere, which is generally cold blast, and the iron becomes decarburized, and ready for the shingling hammer. This is known as the *finery process*. In the manufacture of high class wrought iron, it is usual to give the iron a preliminary refining, in a *run out furnace*. This is a cupola or small blast furnace, in which many tuyeres blow down upon the molten iron, thus oxidizing a great deal of the carbon and most of the silicon. The decarburized iron is run into cast iron moulds, cooled suddenly by water circulating through their hollow walls. The solidified mass or *plate iron* is broken up, and is then ready for puddling, or for treatment by the finery process.

Refiner.—One who refines, or clarifies metals, etc., from impurities.

Refinery.—A place where some crude material, as sugar or petroleum, is purified; also a place where metals are refined, or where grey iron is converted into white, this being necessary as the former becomes molten without passing through the pasty stage.

Refining.—The later or final processes of purifying to which oil, sugar, spirits, metals, etc., are subjected.

Refining Gold.—The act of parting it from other metals, especially silver. In one process the metals are boiled with sulphuric acid, which dissolves the silver, leaving the gold behind. In another, chlorine gas is passed through the molten alloy, which converts the silver into chloride which is easily poured off the surface of the gold.

Refit.—To fit or prepare again; to restore after damage or decay.

Reflecting Power of Bodies.—That part of light or heat reflected when a polished body, like sheet tin, steel or silver, is struck by a ray of light.

Reflection.—The act of reflecting, or turning or sending back, or the state of being reflected; as, return of rays, beams, sound, or the like, from a surface.

Reflector.—A polished surface, that reflects or throws back rays of heat or light that strike upon it.

Reflux Valve.—In hydraulics, a flap valve, used for the purpose of taking off the pressure of a head of water, acting in a backward direction against a set of pumps.

Refraction.—In natural philosophy, the change in the direction of a ray of light, heat or the like, when it enters obliquely a medium of a different density from that through which it has previously moved.

Refractory.—Resisting ordinary treatment, said especially of metals and the like; not readily yielding to heat or to the hammer; difficult of fusion, reduction, or the like.

Refrigerant.—1. The volatile agent whose liquefaction and subsequent expansion, furnish the means of abstracting heat in mechanical refrigeration.

2. Anything that cools or refrigerates.

Refrigerating Machine.—An apparatus for producing low temperatures by mechanical means. Heat is generated by compressing some fluid, such as air, ammonia, ether or carbon dioxide, and then dissipated into the circulating water. Next, the cooled compressed fluid is permitted to expand within suitable chambers or pipes, abstracting the heat necessary for expansion from its surroundings and thus creating artificially low temperatures or "cold."

Refrigeration.—Artificial cooling, either by the application of ice or other cool body, or by utilizing the latent heat of evaporation.

Refrigerator.—1. An insulated chamber, cupboard or cabinet, maintained at a low internal temperature, by means of ice or connection with some refrigerating system.

2. A sort of economizer, fitted in connection with jet condensing engines, using sea water. The feed is pumped through a cylindrical vessel, within which are a number of copper pipes, conducting the brine continually blown off from the boilers. The waste heat from the brine is thus utilized to heat the feed water, thus promoting economy.

Refrigerator Car.—A freight car, lined with insulating or non conducting material, and fitted with receptacles for holding ice. These cars are used in the transportation of perishable goods.

Refrigerator Condenser.—That part of a mechanical refrigerating plant, wherein the volatile agent is cooled under pressure by contact with metallic surfaces, and is consequently liquefied. The condenser is of two types, *submerged* or *evaporative*.

Refuge.—In railways, a recess in the parapet of a bridge or viaduct, or in the walls of a tunnel or cutting, to permit workmen to get out of the way of passing trains.

Refuse.—Matter of no value; sweepings; dross; trash.

Refuse Destructor.—A furnace, wherein the refuse of modern cities is burned to ashes at a very high temperature, the arrangement of flues, etc., being such that noisome odors and gases are consumed before emission by the chimney. The contents of street carts are shot into a feeding hopper which supplies the fires, the cells being alternately charged.

Regelation.—In ice making, refreezing; secondary freezing. A phenomenon observed when ice is subjected to pressure, this lowering the freezing point and causing some of it to melt; when the pressure is removed the ice freezes again, this second freezing being known as *regelation*.

Regenerating Brine.—In refrigeration, the process of adding more salt to a brine that has absorbed moisture from the atmosphere, so as to maintain its proper strength.

Regenerative Furnace.—In metal working, a furnace in which the outgoing heated volatile products are caused to heat a mass of material, which, when the direction of the current is reversed, heats the incoming air or gas with which the furnace is supplied.

Regenerator.—An arrangement of perforated brickwork within chambers arranged in pairs, for recovering waste heat from furnaces, etc. The products of combustion are passed through one series, warming up the brickwork, and converting it into a reservoir of heat, while the air supply to the furnace is passed through the other series of chambers receiving heat already stored up from the previous passage of gas. The regenerators are thus alternately used *on gas* and *on wind*, or in receiving waste heat, and returning it with useful effect.

Register.—In steam heating, (1) a device for controlling the passage of heat or air, like a damper; (2) a grating or perforated plate, with valves regulating the opening of a duct for heating or ventilating purposes; (3) A shop term applied to the fitting of one section to another, to cause parts to coincide accurately. The term is applied to the good *fitting* of pins and holes, rebates, rings, etc.

Register Gate.—In hydraulics, a cylindrical sleeve perforated with vertical ports, around the casing of certain inward flow turbines, to control the flow of water, by opening or closing the corresponding ports in the circumference of the casing.

Registering.—1. In printing, such a regulation of the pages that the lines on one side of a printed sheet shall exactly correspond in position with the lines on the other side.

2. In chromo lithography, the adjusting of the stones, for the different colors, so that each shall make its impress on the correct position upon the plate, so that the colors shall not overlap or be out of place.

3. The act of recording or setting down in writing; the official entering and noting of facts, of persons, names for any particular purpose, of legal documents and the like.

Registering Barometer.—A self registering device for recording variations in the pressure of the atmosphere. The expansion or contraction of the corrugated cylinder of an aneroid is transmitted by gearing to a needle arm carrying a pen or pencil which moves across a paper coiled on a clockwork driven drum.

Regulating Box.—In paper making, the vessel into which the pulp is pumped from the agitators or stuff chests so that its supply to the paper machine can be regulated, superfluous pulp running back through an overflow. Also termed *supply box*.

Regulation.—A term used in engineering in reference to steam engines, meaning that the admission of steam to the cylinder is regulated, so as to insure uniformity of speed.

Regulator.—1. Any mechanical contrivance designed to secure uniformity of motion, flow, temperature, power, etc.

2. A self acting mechanical device for controlling the flow or supply of water, gas, steam, electricity, etc.

3. The controlling valve of a locomotive, operated as a throttle, by the motion of levers, instead of being opened by turning a threaded spindle, as in stop valves.

4. A small lever in a watch, which shortens or lengthens the hair spring, thus causing the watch to go faster or slower.

5. A device for moving a pendulum weight, up and down in a clock, making it go slower or faster, as the pendulum is lengthened or shortened.

6. A central clock, electrically connected with other distant timepieces, causing them to keep time the same as itself.

Regulus.—In metallurgy, the *button globule* or mass of metal, in a more or less impure state, which forms in the bottom of the crucible in smelting and reduction of ore, especially of gold and silver.

Reheater.—1. A sort of stove or furnace, fitted to compressed air power transmission plants, whereby the air from the mains is heated before going to the motor, gaining a large economy by the increase in volume

due to heating the air and obviating the troubles due to a frosty exhaust. By heating air at 40 lbs. pressure to 300° F., a gain of 35% in work has been obtained, as compared with the same weight of air, used cold.

2. In a compound engine, a receiver between the high pressure and low pressure cylinders, so constructed that the exhaust from the high pressure cylinder is reheated before entering the low pressure cylinder by live steam from the boiler. Sometimes called *reheating receiver*.

Reheating.—The process of making hot again; specifically, bringing piles, fagots or ingots of iron or steel once more to a proper heat preparatory to subjecting them to a further rolling or hammering; as, *reheating* a billet between the cogging and finishing trains.

Reinforced Concrete.—A cement concrete reinforced by steel bars and rods disposed through its mass in such a manner, that tensile stresses are borne by the steel, which possess great tensile strength, while compressive stresses fall upon the concrete itself, which is strong in compression but weak in tension. Also known as *ferro concrete*, *armored concrete*, etc.

Reinforced Pump Valves.—Rubber or fabric valves having wire coils or metallic plates inserted in their middle to stiffen them against buckling. Not to be confused with certain types of metallic valves for heavy work which have india rubber or leather faces to minimize shock and prevent hammering.

Reinforcement.—In building, the incorporation of steel rods, wires, beams or lattice work into the mass of concrete so that tensile strains may be more easily resisted.

Reins.—In blacksmithing, a loop or ring slipped over the handles of a pair of tongs to secure their grip of anything seized between the jaws.

Rejected Heat.—In steam engineering, that heat which cannot be utilized in existing types of heat engines, consisting chiefly of the heat units passing away with the exhaust or in the condensing water, such heat usually being four fifths or more of the total heat in the steam.

Relative Velocity.—A term denoting the velocity of a moving body *relatively* to the motion of another body with which it is co-ordinated; as, the motion of steam in a turbine, is said to have a velocity relative to the speed of the blades. The term *absolute velocity* refers to the velocity of the working fluid, when the turbine is at rest, as compared with its frame. Strictly speaking, all motion must be relative; that is, it must be regarded as taking place in relation to some point assumed to be at rest.

Relax.—To make lax or loose; to abate in severity; to become less rigorous.

Release.—In steam engineering, the point on an indicator diagram, denoting where the valve has opened to exhaust, before the completion of the power stroke. Strictly speaking, the period from the opening of exhaust until the end of the stroke is called *pre-release*; the remaining period of exhaust till the beginning of compression is called *release*.

Release Line.—In an indicator diagram, a term sometimes applied to the exhaust or back pressure line.

Relief.—1. In architecture, the projection of a figure above the ground or plane on which it is formed.

2. In civil engineering, in the construction of fortifications, the height to which works are raised above the bottom of the ditch.

3. In painting, the appearance of projection given by shading, shadows, etc., to any figure.

Relief Frame.—In a steam engine, an attachment to slide valves which, by pressing tightly against the casing door, excludes steam from the back of the valve, consequently diminishing the load, reducing friction and economizing power.

Relief Valve.—An escape or safety valve fitted to the feed pumps on steam engines so that damage may not result through accidental closing of the check valves. The terms, escape and relief valves, are used interchangeably for the spring loaded valves set on steam engine cylinders, etc.; the term, *safety valve*, being applied to those valves fitted on boilers, superheaters, evaporators, or generators of any kind.

Relieving Tackle.—A system of tackles fitted from a tiller to the sides of the ship or wheelhouse to steady the rudder and act as a brake in bad weather.

Remainder.—In arithmetic, that which remains of a greater number after a less has been subtracted from it, or the over-plus remaining after the division of one number by a second, which is not an exact divisor.

Remedy.—That which corrects or counteracts an evil of any kind; a corrective; also that which relieves or cures a disease.

Rend.—To separate into parts with force or sudden violence; to split; to burst.

Rendering.—1. The process of extracting or refining fats, oils, etc., from animal tissues by heat.

2. The first coat of plaster laid upon a wall.

Rent.—1. An opening made by rending; a break or breach made by force.

2. A certain sum agreed upon between a tenant and his landlord, paid at fixed intervals by the lessee to lessor for use of land, house, etc.

Repair.—To restore to a sound state after decay, injury, dilapidation, or partial destruction; as, to repair a wall, or a ship.

Repair Outfit.—A kit of tools, cements and materials, necessary to effect repairs on such things as leather or rubber belting, pneumatic tires and similar fabrics.

Repair Part.—A duplicate portion of a mechanism carried to replace a detail which may break or give away in service; similar to the *spare gear* carried on a steamship.

Reparable.—Capable of being repaired.

Repeating Decimal.—A decimal fraction, in which one figure is repeated indefinitely; as, 0.3, which is the method of expressing 0.33333.

Repel.—In mechanics, to act with force in opposition to force impressed; to exercise repulsion.

Repetition Work.—That in which exactly similar articles are made, one after another, the operations being facilitated by the use of jigs, chucks, templates, etc., which tend to make parts interchangeable as well as promote rapidity of manufacture.

Replace.—To place again; to restore to a former place, position, condition, and the like.

Replenish.—To fill again after having been diminished; to stock anew; hence, to fill completely.

Replevin.—In law, a personal action which has to recover possession of goods or chattels wrongfully taken or detained.

Repose.—To cause to stop or rest after motion. In physics, the *angle of repose* is the inclination of a plane at which a body placed on the plane, would remain at rest, or, if in motion, would roll or slide down with uniform velocity; the limiting angle at which the various kinds of earth will stand when abandoned to themselves.

Repoussé Work.—In engraving, a kind of chasing. It is effected entirely by the hammer. The workman uses a plain flat sheet; as, of silver, having before him a model of the article to be produced. The plate rests upon a soft bed of pitch or other composition, and with a small hammer the workman produces indentations on the inner surface of the plate, corresponding to the design. A small steel punch is in some cases employed, and if the relief is accidentally made too high, it is reduced by counter hammering.

Repulsion.—1. The act or effort of forcing back; driving in the opposite direction, causing to recede.

2. A physical force which compels certain bodies or their particles to recede from each other; the reverse of attraction.

Requirement.—That which is required; an imperative or authoritative command; an essential condition.

Requisites.—Those things which are so necessary that they may not be dispensed with. A *requisite* differs from a *requirement* in that the latter signifies what is required of or by a person, while the former conveys the idea of something material or to be possessed, in view of the nature of the case.

Reredos.—1. In architecture, the wall at the back of an altar or seat.

2. A projecting buttress on the back of a fireplace, or a movable plate occupying a similar position. It is called a *fire back*, and its office is to throw the fire forward so that it may radiate into the room.

Resawing Machine.—A slitting circular saw for getting boards, etc., from previously sawed lumber, being fitted with guides, gauges and stops to secure uniformity of product.

Reserve Style.—In cotton manufacture, a method of calico printing in which the white cloth is impressed with figures in resist paste, and is afterwards subjected first to a cold dye as the *indigo vat*, and then to a *hot dye bath*, the effect being the production of white or colored spots upon a blue ground. Also known as the *resist style*.

Reservoir.—1. A place where anything is kept in store; especially, a place where water is collected and kept for use when wanted; as, to supply a fountain, a canal, or a city by means of aqueducts, or to drive a mill wheel and the like; a cistern; a mill pond.

2. A vessel, generally cylindrical in form, containing compressed air, which is stored in it for supplying the air brake and train signal

systems; similar reservoirs are used in connection with the vacuum brake. A locomotive is usually furnished with one or two main reservoirs, brake valve reservoir, and auxiliary one for the driving wheel, truck and tender brakes.

Resharpening.—The act or process of putting a keen edge upon tools which have become dull by use; by extension, the process of renewing the sharp teeth of worn files by means of the sand blast, etc.

Reship.—To ship again; to ship; as, anything which has been conveyed by water or imported; as, an article imported into New York and reshipped to Liverpool. The act of reshipping or loading on board a ship a second time.

Residual Gases.—In gas engines, a term applied to the products of combustion left in the cylinder of a gas engine after the explosion of the charge. Carbonic acid is the principal residue.

Residue.—A remainder from a chemical process; that which is left after evaporation; solid matter undissolved by an acid solution.

Residuum.—1. That which remains after any process, more especially with boiling or distillation.

2. Tar remaining from petroleum after the illuminating oils have been distilled therefrom.

Resilience.—The act or quality of elasticity as understood by physicists; the property of springing back or recoiling upon removal of a pressure, as with a spring. Without special qualifications the term is understood to mean the work given out by a spring, or piece, strained similarly to a spring, after being strained to the extreme limit within which it may be strained again and again, without rupture or receiving permanent set.

Resin.—Sometimes written rosin. A solid gum like substance exuded from various trees, or left as a residue from the distillation of turpentine.

Resist.—1. In mechanics, a coating of any kind applied to a surface to protect it from corrosion or the action of other chemical agents.

2. In calico printing, a substance used to prevent a color or mordant from fixing on those parts to which it has been applied, either by acting mechanically in preventing the color, etc., from reaching the cloth, or chemically in changing the color so as to render it incapable of fixing itself in the fibers. The pastes prepared for this purpose are called *resist pastes*.

Resistance.—In physics, the quality of not yielding to force or external pressure; that power of a body which acts in opposition to the impulse or pressure of another, or which resists the effect of another power; as, the resistance of the air to a body passing through it; the resistance of a target to a projectile.

Resolution.—1. The act of unraveling a perplexing or complicated problem.

2. The act of separating a body into its component parts; as, by chemical means or by observation under a microscope.

3. The mathematical process of analyzing velocities, forces or similar quantities into components having different directions; a term used in higher mathematics.

Resolution of a Force.—In physics, the process of discovering the magnitude and direction of two or more forces so that their resultant is identical with the force which is being resolved. It is the antithesis of *composition* of forces, for instead of finding the single force which is the resultant of several, it finds out the various components of a given resultant.

Resolvent.—Anything which has power to reduce something else to a state of solution.

Resonance.—In acoustics, prolongation or increase of sound, produced either by reflection or by sympathetic vibration of other bodies than that which produces it; *reverberation*.

Rest.—1. To place on a support or base; to be supported or fixed.

2. That which is left over; a remainder.

3. A device for supporting a piece of work, more especially in conjunction with a vise.

4. In a lathe, that attachment to a machine tool which supports and traverses the cutting tool; *slide rest*.

Restarting Injector.—In steam engineering, an appliance designed for use in connection with locomotive and marine engines, which being subject to shock sometimes renders the ordinary injector unreliable. In this injector, the steam nozzle is closed by a double seated valve of conical form; when it is opened an annular jet of steam issues from an *angular lifting nozzle* and creates a partial vacuum which lifts the water to the injector; a second nozzle called the *forcing nozzle*, forces the water into the boiler. If from any cause the action be interrupted, as from a failure in the water supply, the lifting nozzle will always tend to produce a vacuum in the suction pipe which will again lift the water as soon as the water supply is renewed.

Restoration.—The act of restoring or bringing back to a former place, station, or condition.

Restore.—To repair; to bring back from a state of ruin, decay, and the like.

Restrain.—To draw back again; to hold back; to check.

Restrict.—To restrain within bounds; to limit; to confine.

Result.—In arithmetic, the end of an operation; the conclusion or end to which any course or condition of things leads.

Resultant.—In mechanics, the sum of two or more separate forces which act upon a body in different directions, not equal and opposite, causing it to move, or producing a tendency to move in a definite direction. In other words, it may be defined as a single force which replaces two or more other forces, and which is *equal to their sum*.

Resume.—To begin again; to recommence; as, something which has been interrupted.

Ret.—To prepare for use, as flax, by separating the fibers from the woody part by a process of soaking, macerating, and other treatment.

Retail.—The sale of commodities in small quantities or parcels; to sell directly to the consumer; opposite to *wholesale*.

Retainer.—A device fitted to the races of a ball or roller bearing so that the balls or rollers may be retained in place.

Retaining Chain.—In railways, one used to hold in position the bellows extension of a vestibule when not coupled to another car.

Retaining Wall.—A masonry wall erected to retain the sides of an excavation if steeper than the angle of repose of the soil, or should the slope be made of treacherous soil.

Retard.—To keep delaying; to continue to hinder; to prevent from progress.

Retardation.—In mechanics, a decrease of velocity or speed of movement on the part of anything, either from internal causes or from being hindered in its free progress.

Retardation of the Tide.—In navigation, the lunital interval or the *hour angle* of the moon at the time of high

tide at any port; the interval between the transit of the moon and the time of high tide next following.

Retarded Combustion.—In steel making, a method of producing gaseous fuel, as in the Siemens producer for steel works. Fuel, usually of the inferior descriptions, is burnt in a closed chamber with insufficient air, producing carbon monoxide, this is led through ducts to the required furnace and burnt to carbon dioxide, producing heat and flame.

Retarder.—In a steam boiler, a spirally curved lath of metal placed in the fire tubes to check the speed of the gases, and cause them to part with more of their heat.

Retinite.—An inflammable mineral resin, usually of a yellowish brown color, found in roundish masses, sometimes with coal.

Retort.—1. A vessel, exposed to external heat, in which are placed substances to be distilled or volatilized.

2. A glass lined vessel, used in laboratories, having a globular body with a bent neck.

3. A clay lined vessel of oval or D section in which coal is volatilized to make illuminating gas.

Retort Drawing Apparatus.—In gas manufacture, a machine designed to obviate the severe labor of drawing the incandescent coke from the retorts after distillation. A frame travels on rails along the front of the benches, and carries scoops which are thrust into the opened mouth of the retorts, withdrawing the coke, and passing it to a conveyer, which removes it to the cooler and thence to the stack. The same machine or a modification is also used to *charge* the retorts, that is, fill them with the coal from which gas is to be distilled.

Retort House.—In gas manufacture, that building in which the process of distillation is carried on, the one containing the benches of retorts.

Retract.—In mechanics, to draw back or backward; as the trigger of a gun; to draw in; as, in a sheath. Opposed to *protract* or *protrude*.

Retrenchment.—To lessen; to cut off; to pare away; as, "it is more reputable to *retrench* than to live embarrassed."

Retting Flax.—The fiber of the flax plant is a sort of inner bark lying between the stem and the bark proper. It is surrounded by a gummy matter which is dissolved out by *retting* or *rotting*; this consists in steeping the flax in water until it begins to decay. The process of retting also breaks up

the "bone" or stem so that it may be removed by *scutching*.

Return.—1. A coming in or back again. In reciprocating machine tools, the return or return stroke is the idle stroke alternating with the cutting pass of the work under the tool or the tool over the work.

2. In architecture, the continuation in a different direction, often at a right angle, of a building, face of a building, or any member; as, a moulding or mould, applied to the shorter in contradistinction to the longer; thus, a *facade* of sixty feet east and west has a return of twenty feet north and south.

Return Bend.—A pipe fitting, shaped like the letter U. It is used to connect pipes forming stacks, coils, etc.

Return Column.—In hot water heating, the down setting main pipe from the upper portion of the system.

Return Elbow.—A return or U bend of small radius. The return bend is usually a bent piece of pipe, the return elbow is cast iron, malleable, or steel, bent to a radius about equal to the nominal bore of the pipe.

Return Flue Boiler.—In steam engineering, a boiler fitted with flues through which the products of combustion are returned.

Return Idlers.—Bottom rollers or idle pulleys upon which a conveyer belt passes on its return beneath the conveying part.

Return Tubular Boiler.—In steam engineering, a boiler fitted with tubes through which the products of combustion pass.

Reverberatory.—Producing or intended to produce reflecting, deflecting; as, the deflecting of the flames and gases in a reverberatory furnace.

Reverberatory Furnace.—So called when the flame, in passing to the chimney, is thrown down by a low arched roof upon the materials operated upon; a hearth with a fire at one end and a chimney at the other.

Reverse Curve.—One whose curvature is first in one direction and then in the opposite direction.

Reversed Cycle.—In physics, the operation of the Carnot, or ideal cycle reversed, corresponding to the action which takes place when work is expended on a gas; as, with air compression and refrigeration.

Reverse Lever.—In a locomotive, a lever, pivoted to the framing or the footplate, which moves the reverse shaft, and consequently the links, into any desired position through the intervention of the reach rod. The lever has a latch, which engages with notches in the sector or quadrant, to lock it in any desired position. Many English locomotives have a screw gear to move the reverse lever, and their heavy freight engines frequently have steam reversing gear to save physical labor on the part of the enginemen. On American locomotives springs are provided to counteract the weight of the valve gear.

Reverse Motion.—An arrangement of spur or bevel gearing whereby reversal of direction may be imparted to a mechanism, through bringing either a single or a double train into gear. Such devices are employed in motor cars, motor boats, the feed mechanism of turning lathes, and other machine tools, and in numerous other applications.

Reverse Shaft.—In a locomotive, a bar or shaft, lying in bearings upon the engine framing and transversely to it, which is acted upon by the reverse lever and reach rod through one of its arms, communicating that movement through other arms to the link motion, so that the valve gearing of each cylinder is simultaneously moved in the required direction. Also known as *rocking shaft*, *lifting shaft*, *wiper shaft* and *weigh bar*.

Reverse Valve.—A valve fitted to steering or hoisting engines, where reversal of motion is effected by changing steam passages to exhaust, and vice versa; the slide valves in such case having neither lap nor lead.

Reversibility.—The capability of reversal; that is, of moving at will in either of two contrary directions or of performing two opposite functions; as, the *reversibility* of a marine engine, to go ahead or astern, or that of a dynamo, which if supplied with power will generate electricity, or if supplied with electricity, will become a motor and produce power.

Reversible Jaw Chuck.—One in which the dogs or jaws may be taken off and put on again in the reversed direction; they being usually made with steps on one side and grooves on the other, by turning them around they can be used to grip either a flat plate or a boss.

Reversing Cam.—A cam operating the valves of a gasoline engine, so arranged that by shifting it along the shaft or by reversing its motion, it will cause the engine to run in the reverse direction.

Reversing Gear.—A device whereby the valves of an engine may be so operated as to effect motion in either direction at

will. The most common type of reversing gear is a *link motion*; next, possibly, comes the Walschaert and various types of *radial gear*, such as the Joy and Marshall.

Reversing Rolls.—In steel making, a train of rolls fitted either with a reversing engine or a clutch gear, so that the motion may be reversed. Reversing rolls are necessary in dealing with heavy pieces, such as, armor plates, large ingots, and the like, where two high rolls are employed, as it is difficult to lift the pieces over the rolls for each alternate pass.

Reversing Shaft.—In a steam engine, the bar or shaft lying across the engines which connects all the valve gears and moves them simultaneously.

Reversing Valve.—A valve fitted to blast furnace stoves, Siemens regenerative furnaces, gas producers and the like, whereby the current of air is deflected from one stove or heater to another.

Reversing Wheel.—In a steam engine, the large hand wheel of a reversing gear.

Revetment.—Masonry walls placed up and down stream each side of a bridge, to protect the river banks from scour or erosion.

Revise.—To look again for the detection of errors; to review; to re-examine.

Revoke.—To annul by recalling or taking back; to cancel; to reverse.

Revolution.—A motion in a closed curve around a center, or a complete circuit made by a body in such a course.

Revolve.—To turn or roll around on; as, a wheel on an axis; to rotate.

Revolver.—A pistol having in its breech a revolving cylinder bored with from five to seven chambers, each containing a cartridge, which are brought successively into line between the lock mechanism and the barrel, thus giving a number of shots at one loading.

Revolving Derrick.—An apparatus for both hoisting and swinging great weights. It consists of a vertical mast supported by guys, and a boom hinged at the lower end for carrying the load. At the bottom of the mast is a bull ring or large wheel which receives the ropes used to revolve the derrick.

Revolving Door.—A door with four vanes, usually glazed, revolving on a central vertical axis within a curved frame; fitted to entrances of office buildings, etc., where there is much passing in and out.

Rhodium.—A rare metal resembling palladium, found in platinum ores. It is silver gray and only fuses in the oxygen-hydrogen blowpipe, being also insoluble in acids when in the mass. It is sometimes used in an alloy for tipping pen points, but chiefly with platinum, in making the thermo couple of the Le Chatelier pyrometer.

Rhomboid.—In geometry, an oblique angled parallelogram.

Rhombus.—In geometry, an equilateral rhomboid.

Rhumb Line.—In navigation, a line which crosses successive meridians at a constant angle. To sail on a rhumb is to sail continuously on one course following a rhumb line.

Rib.—1. That which resembles a rib in form or use; as, a piece of timber to which the planking of a boat is fastened.

2. An arch shaped piece of timber for supporting the lath and plaster work of a vault; also, a moulding or projecting piece upon the interior of a vault.

3. A strengthening part of a cast iron frame.

4. In coal mining, a narrow wall or strip of coal left as a support.

Ribband.—1. In building, a long narrow strip of timber.

2. In boat building, a long narrow strip of timber fastened lengthwise to the moulds and used to hold the ribs in place while planking.

Ribbed Flue.—A furnace flue for marine and other boilers, in which the cylindrical tube is supported by means of ribs rolled upon its surface, these stiffening ribs being about 1½" deep and 8 to 9 inches pitch. The formation of circular ribs converts the furnace into a sectional tube, similar to the employment of an Adamson joint.

Ribbed Tubes.—In steam engineering, the ribbed tubes introduced with a view to improving the heating surface of the tubes of feed water heaters. The tubes are simply rolled with internal deep ribs running transversely. They are made in iron, steel, copper and brass. Also called *corrugated tubes*.

Ribbon.—1. A narrow wove strip of textile fabric, usually of silk or other superior material.

2. A narrow strip or band of textile material charged with ink, which is used in a typewriting machine, to feed ink to the falling type.

3. A long, thin, narrow strip of metal or other material, resembling a ribbon or tape in its appearance.

4. In carpentry and shipbuilding, the same as ribband.

Ribbon Conveyor.—A spiral conveyer of skeleton construction, there being a clear space between the flight and the shaft or pipe upon which it is mounted. Sticky materials, such as tar, asphalt, molasses and beet sugar materials, are apt to clog an ordinary flight conveyer where the spiral joins the shaft; this is prevented by the open space of a ribbon conveyer.

Ribbon Shield.—In a typewriting machine, a guard or plate to cover the inked ribbon.

Ribbon Spool.—In a typewriting machine, one of two reels or drums for the inked ribbon, it being wound from one to another, as it is used.

Rich Liquor.—In refrigeration, the ammoniacal liquor used in the absorption process, having a density of about 26° Beaumé.

Rid.—To drive away; to remove by effort or violence; as, to get rid of evil company; or a disturbance in the running of a line of shafting.

Riddle.—A sieve with coarse meshes, usually of wire, for separating coarser materials from finer; as, cinders from ashes, gravel from sand, and the like.

Riddlings.—The residual lumpy material left in the riddle after the riddling or sifting of foundry sand. The smaller the proportion of riddlings, the better the quality of sand.

Rider.—1. In mining, a deposit of ore overlying the principal lode.

2. In navigation, a second tier of casks in a hold; a rope which crosses another and joins it.

3. In shipbuilding, a rib within the inner sheathing, bolted through the latter into the main ribs and planking, for the purpose of stiffening the frame. The riders extend from the keelson to the orlop beams.

Rider Plate.—1. Any device that rides astride of or upon, or weighs down something else; as, the thick plate on the top of the center keelson of a ship.

2. A detail in the valve gearing of stern wheel engines, through which the wipers act on the valve levers.

Ridge.—1. A high place between two hollows; specifically, the strip of land thrown up by a plow or left between two furrows,

or anything which resembles the ridge left by the plow.

2. A crest or high point; as, the summit of an abrupt ascent or the highest part of the roof of a building, where the upper ends of the rafters meet.

Ridge Cappings.—In architecture, the covering which runs along the ridge of a roof.

Ridge Mouldings.—Mouldings of sheet metal, copper, zinc or lead for covering the ridge of a triangular roof.

Ridge Pole.—In architecture, the board or piece of timber forming the *ridge* or apex of a roof.

Ridge Rib.—A rib forming a division at the top of adjacent *severays* or compartments in a vaulted roof between two main ribs.

Ridge Roof.—An exterior upper covering of a building having a crest formed by two slopes; a roof whose rafters meet in an apex.

Ridge Tiles.—Ornamental tiles fixed on the ridge board or apex of a roof.

Riding.—In machinery, when owing to loose fitting shafts, or to bad centering of cog wheels, they slip out of gear and the points of the teeth of one come into contact with the teeth points of its fellow, they are said to ride or *over ride*.

Riffler File.—A file having two curved cutting ends with a straight bar portion between, which serves as handle, the whole ranging from 5 to 9 inches long. Such files are used by die sinkers, carvers, pattern makers and stone masons, for work in grooves and recesses. The shapes and cut of the curved ends vary considerably.

Rifles.—In goldwashing machinery, etc., strips or bars placed across the bottom of sluice box cradles to retain the precious metal.

Rifle.—A firearm, discharged from the shoulder, like a musket, which has its bore *rifled* or grooved with a spiral twist so that the bullet, expanded by the explosion, may fit the grooves and have a rotary motion imparted to it thereby. This causes the bullet to traverse a flatter arc, or have a *lower trajectory*, in its flight, and imparts greater surety and directness to the aim.

Rig.—1. The style or arrangement of masts and sails in a vessel, as fore and aft *rig*, schooner *rig*, ship *rig*, etc.

2. To furnish the masts, yards, etc., of a vessel with rigging.

3. To erect, thrust out or prepare a spar, purchase or tackle of any sort after the manner of rigging a ship.

4. A local usage signifying an apparatus or outfit of tools for any particular purpose, more especially for well boring; as, a *drilling rig*.

Rigger.—1. A workman, usually a seaman, employed in shipyards to erect or set up the rigging of vessels; also, a specialist in the erection of steel frame buildings.

2. A name occasionally applied to a belt pulley, especially a fast and loose pair.

Rigging.—The system of cordage upon a vessel; designated according to its purpose, either as *standing* or *running rigging*. The former includes shrouds, stays, guys, etc., which mutually brace the masts and bowsprit to each other and to the hull, as well as the slings, pendants, etc., which support yards and gaffs. The running rigging comprises all that is moved in the operations of sailing the vessel; the halyards, lifts, and braces for manœuvring the yards which support the sails; sheets, brails, clew lines, etc., for spreading or furling the sails; signal halyards, for hoisting flags, and so on.

Right.—Straight; not crooked; upright from a base; having an upright axis; as, a right angle, a right cone.

Right About.—A turning directly about by the right, so as to face in the opposite direction; also the quarter directly opposite; as, to turn to the *right about*.

Right Along.—A common term, meaning straight way; without delay; right away or right off; as, to work *right along* for several hours.

Right Angle.—That which is formed by one line meeting another so as to make equal angles with each other. The lines forming a right angle are perpendicular to each other.

Right Angled Triangle.—In geometry, one which has one of the angles a right angle.

Right Cone.—In conic sections, one where the point lies in a perpendicular from the center of the base.

Right Cylinder.—One whose sides and axis are perpendicular to the base, as distinguished from an oblique cylinder, whose axis is slanting.

Right Handed Screw.—A spiral screw whose threads are so cut that, in entering a nut, the latter must be turned *right handed* or similar to the motion of

the hands of a clock. On viewing a male screw sidewise, the threads slant to the right, in going from the top to the bottom.

Right Hand Engine.—In steam engineering, a horizontal engine whose fly wheel stands to the right when viewed from the cylinder.

Right Line.—In geometry, a straight line; one not curved or bent in any way.

Right of Way.—The right, general or special, of a person to pass over the land of another who is the owner by title.

Right Sailing.—In navigation, sailing directly east, west, north or south, so as to change either latitude or longitude, but not both.

Rigid.—Firm, stiff, unbending or unyielding. Opposed to *flexible*, and conveying the idea of resistance or opposition to anything which tends to divert or bend.


Rigidity.—Want of pliability; the quality of resisting change of form, opposed to flexibility, ductility, malleability and softness.

Rim.—The border, edge, or margin of a thing; as, the rim of a wheel, usually applied to things which are circular or curving.

Rim Planer.—A machine for shaping at once the four sides of the felloe or rim of a carriage wheel.

Ring.—1. A circle, or a circular line, or anything in the form of a hoop.

2. A hoop of metal used as a link, as a means of attachment or of assembling, or to fit a cylindrical surface.

Ring and Traveler.—In spinning, the distinguishing feature of the ring spinning frame, which imparts the twist to the yarn, as it is wound on the bobbin. It consists of a hardened ring, concentric to the spindle, on which works a small steel loop or hook of  shape, termed the traveler. The roving passes through this traveler, the drag of which, carried by the thread, serves the purpose of the flyer of the earlier machines.

Ring Bolt.—A bolt fastened in the sides or deck of a vessel or to a wharf, having a ring passed through an eye in its head. The ring serves as attachment for a rope or for a tackle.

Ring Frame.—In spinning, the modern spinning machine in which the ring and traveler is used instead of the flyer. It

is also known as the *ring throstle*, and is used for the spinning of warp.

Ring Mallet.—A wooden mallet used by woodworkers, the head of which is kept from splitting by two wrought iron rings or hoops; the handle is usually screwed into the head.

Ring Oiler.—A self-oiling bearing for shafting, etc., in which a ring travels around with the shaft, the lower part of the ring dipping into an oil well below the journal, thus baling a little lubricant up as the ring revolves.

Ring Spanner.—A wrench or key which completely encircles the nut, thus giving a perfect grip and obviating marks on finished work.

Ring Valve Gear.—A method of operating the exhaust pushrod of a four cycle engine, direct from the crank shaft. There are two toothed rings: the inner, which is mounted upon an eccentric sheave, is swept around within the outer fixed ring, skipping one tooth at each revolution. The outer ring has twice the teeth of the inner, plus a *hunting tooth*, which makes a contact of a ring tooth with the exhaust pushrod at each alternate revolution, the pushrod projecting into the space between two teeth of the outer fixed ring. Also called *ratchet valve gear*.

Rink.—An artificial sheet of water, generally under cover, used for skating; also, a floor prepared for roller skating, or a building with such a floor.

Rinser Machine.—In a steam laundry, a washing machine which does the work by repeated application of water.

Rinsing Cup.—A cup or similar vessel, used by painters, in which they wash out their brushes with the aid of a little turpentine, etc.

Rinsing Machine.—1. In cotton manufactures, a series of tanks fitted with rollers and supplied with water colder in each one than the preceding, in which dirt and superfluous dye are washed out of cloth after dyeing or printing.

2. A machine in which bottles have a preliminary rinsing before washing them for using a second time.

Rip.—A body of water made rough by the meeting of opposing tides or currents. A *ripple* is a little wave.

Ripping Chisel.—A chisel made to use as a prying lever, usually 18 to 24 inches long with the point slightly cranked; a short, sharp *crowbar*.

Ripple.—A comb like instrument for cleaning broom corn or flax fiber; a toothed tool used by hand.

Ripple Machine.—In flax or hemp manufacture, a machine having a toothed wheel, worked by means of a treadle, which is used to separate the seeds from the broom flax.

Rip Rap.—In civil engineering, broken stones for making foundations or walls, especially for throwing into deep water to form a bed for further work; also, a foundation of stones thrown loosely together.

Rip Saw.—In wood working, a saw whose teeth are ground squarely to the blade, as used for cutting wood in the direction of its fiber or with the grain. A *cross cut saw*, on the contrary, has each tooth tapered away from its center to either side, like a shark's tooth or the section of a reaper knife.

Rise.—1. In mining, to work or excavate upwards, the opposite of *sink*.

2. In architecture, the rise of an arch is the vertical distance between the springing line and the center or highest point of the *intrados*.

Riser.—1. In building, the vertical portion of the steps of a stairway.

2. In founding, an addition made to a mould, at a greater elevation, so that the complete filling of the mould is assured.

Riser Pipe.—In steam heating, a steam supply pipe extending vertically through a building and having side branches.

Rising and Falling Table.—A machine table used with drilling and other machines, which is made to rise and fall to suit the requirements of different kinds of work.

Rising Mouth.—In flouring, a device applied to chaff cutters, where the cover of the spout is not fixed, but movable and controlled by springs or balance weights, thus permitting the feed rolls to rise and clear themselves if choked.

River.—A natural water course of large size, with a copious flow of water; larger than a brook, creek or rivulet.

River Craft.—Boats that ply or are especially adapted for plying on rivers.

River Gauge.—An upright timber on a pier or river bank, with markings to indicate the height of water above low watermark or other reference point.

Rivet.—A short soft metal bolt, having a head on one end, used to connect two metal plates together; rivets are made both of iron and steel, and there are certain brands of such excellent quality, that they are almost exclusively used in boiler work.

Rivet Boy.—A boy, working with a gang of riveters, who heats the rivets at a small forge designed for the purpose, throwing them as required to his mates.

Rivet Catcher.—In well boring, a dish or cup lowered within a well when riveted casing is being inserted, to prevent rivets, etc., from falling into the hole. Diamond and calyx drills have a ring around the core barrel for the same purpose, it being well known that a few loose iron pieces may prevent the drilling of a well.

Riveted Joint.—A joint secured by means of rivets passing through the various thicknesses, and closed up when hot.

Riveted Stays.—Screwed stays or stay bolts, such as are used in the fire box of a locomotive boiler, screwed through both plates which they stay and then riveted on either end.

Riveter.—A boilermaker who closes rivets. In boiler and shipyard work, the riveters operate in gangs of four; namely, a *rivet boy*, to heat the rivets in the forge; a *holder up*, who presses against the head of the rivet, with a hammer or dolly, while two riveters beat on the point with special hammers, forming it to a neat shape and filling the aperture.

Rivet Forge.—In structural iron work, a portable forge used by boilermakers and iron workers for heating their rivets alongside of the work for which they are required.

Rivet Head.—The head of a rivet is the portion which is first formed, not that which is turned over by the act of riveting, or the *tail*. Rivet heads are *segmental*, *pan*, *snap*, or *countersunk*.

Riveting.—There are several modes of riveting: (1) single riveting consists of a single row of rivets; usually all girth

seams, those running around the body of the boiler, are *single riveted*; the size of the rivets is in proportion to the diameter of the boiler. (2) *double riveting* consists in making the joints in boiler work with two rows of rivets, instead of one; nearly always, horizontal seams are double riveted as well as domes where they join upon the boiler. Rivet holes are made by punching or drilling, according to the material in which they are made. In soft iron and mild steel, they may be safely punched, but in metal at all brittle, the holes should be drilled. The distance between centers of rivets is called the "pitch" of the rivets. Holes should always be drilled in boiler work.

Riveting Machine.—A machine in which the operation of closing rivets is performed by power. The machine consists essentially of two parts, connected together by a hinge or by a solid yoke, one corresponding to the *dolly* which is held up, and the other to the *riveting set*, as wielded by the riveters. The former remains stationary, while the latter is operated either by gearing from a belt, or by means of a piston driven by steam, compressed air, or, more frequently, hydraulic pressure. The action of the dies may be compared to a reversal of the punching machine, as, instead of making a hole, the pressing together of two opposed dies closes the rivet.

Riveting Set.—In blacksmithing, a tool or die used to give a correct shape to rivet heads, under the blow of a heavy hammer.

Rivet Steel.—In iron work, mild steel is now used largely for the rivets of boilers. Good rivet steel should stand bending cold to a curve whose inner diameter is equal to that of the rivet. The heads of steel rivets should be hammered down quickly. Overheating of these is more injurious than in the case of iron.

Rivet Tail.—In iron work, that portion of a rivet which is turned over in the process of riveting; the opposite end to the rivet head which is formed by machinery.

Rivet Tongs.—Small tongs with curved lips to fit the shanks of rivets, by means of which they are transferred from forge to hole, etc.

Road.—1. A public thoroughfare or way whereby pedestrians, passengers, animals and vehicles may go from one place to another: the term implies a made or prepared surface and a certain minimum width, as distinguished from a lane or path.

2. The central part of a city street, devoted to the use of vehicles, etc., as distinguished from the *sidewalks*.

3. In the plural, a safe anchorage for vessels, some distance from the shore; as, Hampton Roads, Yarmouth Roads, etc.

Roadbed.—In a railway, the base or foundation on which the superstructure of a railroad track is laid; the prepared

surface to receive the ballasting, ties and rails.

Road Machine.—One largely used in construction, having one or more scrapers or scoops, usually mounted between wheels, so that it may be used to scrape up earth and transfer it; as, from the sides to the middle of a road or railway bank.

Roadmaster.—On a railroad, the official responsible for upkeep, etc., of the railway track in a division.

Road Metal.—A term applied to broken stone used in the macadamizing and paving of roads.

Road Roller.—A locomotive steam engine whose wheels are replaced by heavy cylinders, furnishing a means for leveling and compacting the surfaces of roads over which it passes; a *steam roller*.

Roasting.—In smelting, the preparatory treatment of ores of metals consisting in heating them at a moderately high temperature in order to volatilize and drive off the deleterious gases, carbonic acid, sulphur dioxide, etc.

Roasting Furnace.—In smelting, a preparatory furnace where copper or other ores are exposed to heat, and variously manipulated to get rid of sulphur, arsenic and other impurities.

Rob.—In mining, to pare away or remove the pillars of coal left to support the roof.

Rock.—In geology, any natural deposit forming a part of the earth's crust, whether consolidated or not, including sand, earth, clay, etc., when in natural beds; a large fixed stone or crag.

Rock Breaker.—A stone crusher; a machine having powerful jaws operated by a series of toggle jointed levers which crush ores and mineral substances.

Rock Drill.—A reciprocating mechanism, mounted in a swiveling frame on a tripod socket, operated generally by steam or compressed air, but sometimes by hand; the reciprocating rod has a removable cutting head, revolves slowly as it works, and is provided with feed gear. Used to drill holes in rock, for shot firing, or plug and feather work.

Rocker.—A concentrating apparatus for fine ores or slimes, consisting of an inclined table, pivoted at one end, which is rocked sideways by the operator as the water is passed over the ore.

Rocker Arm.—In a steam engine, a lever vibrating about an axis, as in various types of valve gearing.

Rocker Box.—In a locomotive, a casting bolted to the engine frame which serves as bearing for the rocker shaft used with indirect valve motion.

Rocket Apparatus.—A gun, mortar or trough, by means of which a rocket, having a line attached, may be fired across a stranded vessel, thus establishing communication between it and the shore; also a *life saving apparatus*.

Rockets.—In navigation, a cylindrical tube of paper or metal, filled with a compressed mixture of niter, sulphur and charcoal, which on being ignited, propels it forward by the action of the liberated gases against the atmosphere. It is used for signal purposes, each steamship line having its own colors as known by an international code.

Rock Faced.—A term applied to masonry where the center part of the face of each block is left rough, either as it came from the quarry, or else simply dressed with a spalling hammer. The outer portion is dressed smooth with a *drafted margin* from one to two inches wide according to the size of the stone.

Rocking Grate.—In locomotives fitted for burning soft coal, a series of *transverse* bars are provided, usually arranged in pairs, one bar each side of the center line of the fire box; these bars are suspended on a series of links, which can be moved at will by levers from the foot plate, thus forming a *rocking* or *shaking grate*, to dislodge clinker and clean the fires.

Rocking Levers.—In steam engineering, the levers which drive the air and the feed pumps on marine engines.

Rocking Shaft.—In steam engineering, a shaft which carries the double ended lever which actuates the slide valve in the indirect acting slide valve type. Also, any shaft or spindle which has a to-and-fro motion only; as, a weigh shaft.

Rock Lifter.—A tripod provided with a combination of differential pulleys and ratchet gear, which is used to lift isolated rocks or boulders from the ground, and where, through the multiplication of power, one or two men at the end of a twelve foot lever can move a great weight; as, a tree stump, etc.

Rock Salt.—Chloride of sodium or common salt, as found naturally underground in a solid or rocky form. It is the saline residue from the evaporation of ancient seas in bygone ages, covered over with other strata in succeeding periods. The salt is either mined in the ordinary way, or else dissolved by water, the brine being pumped to the surface and there re-evaporated and refined.

Rockwork.—In building, stone work in which the surface is left rough and broken.

Rod.—1. A wand, stick or long slender bar of any material, wood, iron, brass, steel, etc.

2. A moving part of a mechanism, which is slender as compared with its length; such as, *connecting rod*, *eccentric rod*, etc.

3. A land measure of $5\frac{1}{4}$ yards or $16\frac{1}{4}$ feet, lineal.

4. A measure for laid brickwork, equaling 272 superficial feet, $1\frac{1}{4}$ bricks thick = $11\frac{1}{2}$ cubic yards = 906 cubic feet = 235 feet of bricks and $\frac{1}{2}$ of mortar = 15 tons, average weight.

Rod Feed.—The device whereby a rod or wire is fed as required through the hollow mandrel of an automatic or turret lathe, consisting of gripping sleeves and jaws, together with releasing catches and pushing parts which are operated at the proper time by cams, etc. More usually termed *wire feed*.

Rodman.—In land surveying, the man whose duty it is to carry the graduated surveying rod, or *staff* by which the levels are read.

Roebling, John Augustus.—Born 1806, died 1869. An American engineer of German birth. Coming to the U. S. in 1831, he became assistant engineer in the slack water navigation of the Beaver River, Pa., after which he turned his attention to the manufacture of wire rope, establishing the Roebling Wire Works. In 1844, he began to devote himself to suspension aqueducts and bridges, building, among others, the Monongahela Suspension Bridge at Pittsburgh (1846), four suspension aqueducts on the Delaware and Hudson Canal (1848-50), the Suspension Bridge over the Niagara River (1851), the Cincinnati Suspension Bridge (1867), and had completed the design of the Brooklyn Bridge at the time of his death, in 1869.

Roebling, Washington Augustus.—Born 1837. An American engineer, son of J. A. Roebling. He succeeded to the charge of the construction of the Brooklyn Bridge, upon the death of his father, in 1869. His intense devotion to his work and his insistence upon personally directing operations in the compressed air caissons, undermined his health, so that, for ten years, from 1873 until the completion of the bridge in 1883, he was a constant invalid, directing operations from his home. The final triumph was due to his great perseverance and wonderful inventive genius,

by which, obstacles never before met, were successfully overcome. Since the completion of his great work, he has devoted himself to the manufacture of wire, as established by his father in Trenton, N. J.

Rogue's Yarn.—Yarn of a different twist and color from the rest, inserted into the cordage of the British navy, to identify it, if stolen, or for the purpose of tracing the maker in case of defect.

Roll.—1. In engraving, the cylindrical die in a transferring press.

2. In manufacturing, a carding of wool, delivered broadside from the cards and somewhat compacted in the process. Rolls are prepared for *hand spinning*.

3. In metal working, one of a pair of cylinders, between which metal is passed to draw it into bar, or to flatten it out into a sheet.

4. In paper making, a cylinder mounted with blades for working paper pulp in the tub.

5. In roofing, a strip with a rounded top laid over a roof at the ridge or at lateral joints, to raise the sheet lead at those points.

6. In bookbinding, a tool for hand embossing or gilding, where a continuous line or pattern is to be impressed upon a book cover.

Roll Bars.—In paper making, the knives set on revolving cylinders, in sets of three in the breaking engine, and in sets of two upon that of the beating engine. Also termed *fly bars*, or simply *bars*.

Rolled Shafting.—Shafting which is finished to size between special rolls, thus avoiding the necessity of turning it.

Roller.—1. An implement used for breaking up the clods of earth after plowing, when it is termed a *clod crusher*, or in its more simple form of smooth cast iron cylinders, as used to consolidate loose soils or turf. Large rollers are frequently made with a watertight interior, so that their weight may be cheaply increased by filling them with water.

2. A revolving cylinder or drum, usually without any shaft or axle; used in mechanism as a means of giving rolling contact along a line, thus diminishing friction.

Roller Bearing.—A bearing in which the journal rests upon and is surrounded by hardened steel rollers which revolve in a race surrounding the shaft. Friction is reduced by its taking place on a line, where the shaft and the roller touch each other, instead of over a surface, as with an ordinary brass.

Roller Bowl.—In textile manufactures, the cylinder or roller in washing or wringing machines; the term bowl is also applied to the rolls of a calender.

Roller Chain.—A power transmitting chain, or link belting, in which each

rivet or joint pin is surrounded by a revolving roller or outside bushing sleeve, which reduces the friction and consequent wear and tear on the sprocket teeth.

Roller Gear.—A variety of spur wheel which has small rollers in its circumference instead of teeth, to lessen friction; it acts like a *lantern wheel* or *wal-lower*.

Roller Milling.—The method of high milling in which the wheat is cracked and cut into flour between grooved and smooth rolls, instead of being ground between millstones.

Rollers.—In a railway, a testing apparatus for locomotives in which the engine's wheels are mounted on rollers or pulleys, so that the wheels may revolve without the engine leaving the shops. This enables new engines to be broken in without risking obstruction on the line, as well as having all parts under close examination; also, it is very useful for holding tests of power and performance.

Rolley.—A horse drawn vehicle similar to a lorry, used in mining.

Rolleyway.—In mining, a subterranean road, along which tubs or corves are drawn by horses.

Roll Feed.—A term applied to wood working machinery when the boards, etc., are pushed towards the cutters by means of fluted rolls, instead of being pulled in by a windlass or pushed by a carriage.

Rolling Blind.—A blind or screen of wooden or metallic slats, hinged together or fitted on a flexible connection permitting it to be coiled up on a drum or roller similarly to a fabric blind.

Rolling Brake.—A brake fitted to various types of cycles in which a roller of india rubber or gutta percha is substituted for a rigid brake shoe.

Rolling Chock.—In a ship, a bilge keel to minimize rolling.

Rolling Circle.—In drawing and designing wheel teeth, the circular pitch line upon which the *generating circle* is assumed to roll.

Rolling Contact.—Contact between a rotating body and the smooth surface which supports or embraces it, as with a wheel revolving on a rail.

Rolling Lift.—A sort of drawbridge or bascule whose shoreward end is pivoted in a rolling race, being driven around by worm gearing or hydraulic rams. The rolling lift bridge needs no high approaches or towers for raising the span.

Rolling Line.—In rack and pinion gearing, the pitch line of the rack upon which the *generating circle* is supposed to roll in describing the teeth.

Rolling Load.—A superposed load on any structure caused by something rolling over it; as, a railway train traveling over a viaduct.

Rolling Mill.—A works where steel or iron is formed into plates, sheets, bars or sections by passing through rolls, the circumferences of each pair being grooved or fluted so as gradually to reduce the ingots or billets nearer to the desired dimensions at each pass.

Rolling Resistance.—The frictional load imposed by pressure upon or between a revolving body and a smooth surface; as, between a shaft and its bearing, when there is no relative movement of the parts in contact. The friction is much less than *sliding friction*.

Rolling Stock.—A general term for the cars, both freight and passenger, and the locomotives, of a railway.

Roll Squeezers.—In rolling mills, rolls used as squeezers for consolidating puddled balls into blooms. The squeezer contains three rolls, two of them side by side and on the same level, and an upper one capable of adjustment.

Roll Turning Lathe.—One designed for turning chilled rolls; owing to the extreme hardness of the skin on the casting, the tool cuts off the iron in sharp needles, being fed in similarly to a parting tool. Self-action is usually impossible within the circumstances, and the feed is generally imparted to the rest by tapping a wedge.

Roman Cement.—A natural hydraulic cement, obtained by calcining and grinding *septaria* or nodules found in the chalk in various parts. It has considerably less strength than Portland cement, but has the advantage of being very quick setting.

Roman Notation.—The method of expressing numbers by letters:

I, V, X, L, C, D, M,
1, 5, 10, 50, 100, 500, 1,000.

In the Roman notation, when any character is placed at the right hand of a larger numeral, its value is added to that of such numeral; as, VI, that is, $V + I$; XV, that is, $X + V$; MD, that is, $M + D$; and the like. I, X, and rarely C, are also placed at the left hand of other and larger numerals, and when so situated their value is subtracted from that of such numerals; as, IV, that is, $V - I$; XC, that is, $C - X$; and the like. Formerly the smaller figure was sometimes repeated in such a position twice, its value being in such cases subtracted from the larger; as, IIX, that is, $X - II$; XIX, that is, $C - XX$; and the like. Sometimes after the sign IO for D, the character O was repeated one or more times, each repetition having the effect to multiply IO by ten; as, IOO, 500; IOOO, 50,000; and the like. To represent numbers twice as great as these, C was repeated as many times before the stroke I, as the O was after it; as, CCIOO, 10,000; CCCIOOO, 100,000; and the like.

Roman Screw.—In hydraulics, a device for raising water by means of an Archimedean or fattened spiral, working within an inclined tube. The revolution of the screw lifts water to a moderate height and discharges it from the end of the tube.

Rood.—A measure of five and a half yards in length; a rod; a perch; the fourth part of an acre or forty square rods.

Roof.—1. In mining, the upper surface of a subterranean passage on the strata lying immediately over a seam of coal.

2. In building, the upper covering of a building, usually inclined, to shed water.

Roof Bar.—A girder or bridge stay for the crown of a locomotive fire box, placed transversely and slung from the outer fire box shell. In English practice the bars are generally placed longitudinally and supported from the tube and back plates.

Roofing.—Materials for covering the roof of a building; the term is generally applied to some felt like substance, sold in rolls and secured to the roof by means of nails and cement.

Roofing Slate.—In carpentry, a thin, flat piece for roofing or siding for houses.

Roof Sheet.—A term applied to the upper portion of the external fire box or wrapper plate of a locomotive boiler, and sometimes to the crown sheet of the internal fire box.

Roof Staging.—A staging used in making or repairing steep roofs, held by hooks, clamps, etc.

Roof Truss.—A set of tension and compression pieces, so arranged as to support the weight of the roof.

Root.—In mathematics, a root of a number is a factor which has to be taken a certain number of times to equal the given number. The number of equal factors to be taken is denoted by a small figure, termed the *index*, placed against the radical sign. Thus, $\sqrt[3]{}$ or $\sqrt[3]{}$ signifies the *second* or *square root* of three, or a factor which taken twice equals three.

Root Pulper.—A machine used to grate turnips and other roots for fodder; essentially it consists of a rotating disc provided with knives like a plane, which shave off the roots as they are pressed into a hopper at the back.

Rope.—A construction of twisted fiber, as of iron, steel, manila and hemp, so inter-twined as to form a thick cord capable of sustaining a severe strain. The distinction between a cord and a rope, other than wire, is made at one inch circumference, although in common speech smaller sizes are often called rope. Ropes are, by seamen, ranked under two descriptions, cable laid and hawser laid; the former composed of nine strands, or three great strands, each consisting of three small ones; the latter made with three strands, each composed of a certain number of rope yarns.

Rope Blocks.—Lifting tackle in which a running rope is employed; except for very heavy weights, rope blocks are far handier for erecting and repairing work than chain blocks, whether differential or geared.

Rope Brake.—In rope making, an instrument or machine to break or bruise the woody part of flax or hemp, so that it may be separated from the fiber.

Rope Crane.—A traveling crane driven by an endless rope of cotton or hemp. The source of power may be attached to or be at a distance from the crane. The cord travels at a very high speed, so that a minimum of power is required to lift a heavy load. The tension of the cord is maintained, and its slack taken up by tightening pulleys having their bearings in sliding frames, which are counter-balanced by suspended balance weights.

Rope Drive.—The transmission of power by means of rope gearing, the ropes being of either hemp or cotton, varying in diameter from $1\frac{1}{2}$ " to 2". The speed of ropes is from 3000 to 7000 feet per minute, 4500 being the average. The pulleys are usually of cast iron, the grooves on their surfaces being from 37° to 45° , the latter being the most common angle.

Joints are made by splicing, the splice being 15 diameters in length, while the pulley should not be less than 30 times the diameter of the rope. Two plans are in use, one with independent ropes, suitable for transmitting power from an engine to numerous lines of shafting; the other, where only one rope is used, passing around all the grooves in turn and being kept taut by a tightener or jockey pulley, this last is very useful for drives at awkward angles or supplying power in series to a number of small units. With either plan the lower side should always be the driving side, and with the independent rope drive, a good horizontal sag should be given.

Rope Gearing.—In power transmission, power is conveniently transmitted to a long distance by means of ropes running at a high speed. They are principally applicable to machinery to which the power has to be conveyed to a considerable distance, as the ropes should hang loosely on their pulleys in order to increase the extent of the arc of contact. The driving power is due principally to the weight of the ropes, and they should fit slack to prevent undue wearing of the strands in the grooves of the pulleys. The pulleys should be large, that of the smallest should not be less than thirty times the diameter of its rope. It is often more convenient to use several small ropes than one or two large ones. The pulley grooves should be turned as smooth as possible to diminish undue wearing of the strands of the ropes.

Rope Grab.—In well boring, a fishing tool, having claws with interior barbs and latches to seize a broken drilling cable and draw it from the bottom of a hole.

Rope Guard.—A rope arranged as a protection along dangerous passages.

Rope Knife.—In well boring, a tool to cut a drilling cable in the hole.

Rope Machine.—One for laying or twisting ropes from strands made of twisted yarn.

Rope Maker.—One who by mechanical or hand devices manufactures rope. Rope makers have existed during the very earliest periods of history, and were at one time prominent mechanics of their period. The first machine used in rope making was in the year A.D., 1429.

Rope Pulley.—A grooved pulley for rope transmission.

Rope Pump.—A pumping device whereby a rope traveling over grooved pulleys at a high speed, absorbs water at one point and discharges it at another by centrifugal force.

Rope Socket.—A device for attaching together the ends of a cord, or pieces of round leather belting, adapted to pass

over a pulley. In well boring, a connection having a threaded female end for the drill tools, into which the drilling cable is fastened with taper plugs of wood or poured lead.

Rope Spear.—A fishing tool with barbs or flukes on its sides to engage in a broken drilling cable which may have fallen to the bottom of a well.

Ropewalk.—A long covered walk; or a low, level building, where ropes are manufactured.

Ropeway.—A line of wire ropes, suspended in air from derricks or pillars, upon which articles may be transported in buckets or slings depending from the rope, the carriers being usually hauled back and forth by smaller ropes wound in or out by windlasses. Much used in mining and other operations for transport over rough or uneven country.

Rope Weight.—A balance weight fitted around a crane rope, to pull it down or unwind it after it has raised its load.

Rope Wheel.—In machinery, a sheave pulley whose grooves receive the bight of a rope for hauling purposes. Rope wheels are used for overhead traveling cranes, hoists, etc.

Rope Winch.—In rope making, a set of three revolving hooks or *whirlers* which, being rotated simultaneously, impart an equal twist to each of the three strands which are going to be laid up into a rope.

Ropeyarn.—A single yarn composed of fibers of hemp, etc., twisted up right handedly, used for various purposes on shipboard. Two or three ropeyarns laid up together form *spunyarn*.

Rose.—A closed and enlarged end to a pipe, perforated with many small holes, for sprinkling, or for suction, to avoid choking of the passages.

Rose Bit.—A reamer, whose cutting edges are so arranged as to cut on the point as well as at the side when enlarging a hole. A conical tool made in this manner is employed to make countersunk holes, and a development of the idea is seen in the *rose cutter* for milling machines.

Rose Cutter.—A milling tool which has grooved edges radiating over it from a point or center, so that it may cut both on sides and point; a *rose bit*.

Rose Nail.—Generally a wrought nail with a flattened conical head, showing facets on a square shank and a chisel point.

Rosendale Cement.—A natural cement obtained from a more or less impure limestone, or mixture of carbonate of lime and carbonate of magnesia with sand and clay, this cement rock takes its name from the town of Rosendale, N. Y., where it was first worked. The stone after being quarried, is broken into small pieces, mixed with anthracite coal and burned to a clinker in suitable kilns. After calcining, the material is sorted over, and that which has been burnt to a proper degree is ground to a fine powder. The resultant cement weighs two thirds as much as Portland, sets very quickly and has less ultimate strength, but is sufficiently strong for ordinary building operations.

Rose Nozzle.—A perforated nozzle, as of a pipe spout, etc., for delivering water in fine jets.

Rotary.—1. Turning as a wheel upon its axle, as opposed to linear or reciprocal.

2. So constructed as to rotate on or around a shaft or axis.

Rotary Crane.—In erecting and operating, one having a jib swinging in a complete circle.

Rotary Engine.—A steam engine in which a continuous motion round an axis is produced by the direct action of the steam, instead of being derived from a reciprocating motion, as in the ordinary engine; as, a turbine engine.

Rotary Filler.—An apparatus for filling bottles with liquids, having a platform or cage revolving in a horizontal plane, which brings the bottles one by one under the filling spouts.

Rotary Fire Engine.—One in which a rotary or centrifugal pump is employed instead of the usual reciprocating pattern.

Rotary Kiln.—A tube, frequently one hundred feet long by nine feet diameter, rotated upon roller bearings and slightly inclined from the horizontal, in which materials are calcined, notably in the manufacture of Portland cement. Finely pulverized chalk and clay together with powdered coal, are introduced at the high end, and the whole is incorporated and burnt to a clinker while passing through the revolving tube to its lower end.

Rotary Press.—A printing press in which the printing surfaces are mounted upon a revolving cylinder, special electrotypes

or stereotypes being curved to suit the cylinder, the impressing cylinders being also cylindrical, while the paper is fed continuously between them from a roll. In the *cylinder press*, so called, the impressing surfaces alone are cylindrical, flat type, etc., being employed, traveling back and forth on a carriage underneath the cylinder.

Rotary Pump.—One which has a circular motion; a pump whose piston or pistons partake of the nature of cams, rotating upon an axis and being in contact at one or more points with the walls of the enclosing chamber. A rotary pump differs from a centrifugal in that the latter, by means of a fan or impeller, imparts velocity to a stream of fluid, while the rotary pump continuously scoops the fluid from out its chamber.

Rotary Snow Plow.—On railroads, one provided with a rotary cutter not unlike a screw propeller, or a huge milling tool, which cuts a path through snow and throws it to one side. An ice plow and flangers clear the rails, while fixed blades cut out the snow to 10' 8" wide where it is not touched by the rotary cutter. The rotary plow has its own engine and boiler of locomotive design, with a tender carrying fuel and water, the whole being pushed by a locomotive.

Rotary Valve.—A valve, in which the disc, plug or other device, used to close the passage, is made to rotate back and forth for opening or closing; as, the Corliss valve.

Rotating Frame.—In mining, a concentrating machine, having a flat convex table, fed at the center; or a similar concave table fed at the circumference, in which the deposit is washed off into two classes by jets of water.

Rotation.—The act of turning upon an axis or center; as, a wheel upon its axis.

Rotative Pumping Engine.—A pumping engine which has a crank and fly wheel, as distinguished from the Cornish, or purely reciprocating types.

Rotor.—In a steam turbine, a part of a machine which revolves as compared with that which remains stationary, or the *stator*. The term was originally applied to the revolving part of an alternating or poly-phase generator, as in some dynamos the field magnets are revolved, while with others, the armature is the moving portion and a general designation was necessary. Since the advent of the steam turbine, the same appellation has been given to the drum or wheel, furnished with blades, which is driven by the steam.

Rotten Stone.—A polishing material made of certain limestones, which upon becoming decomposed have become soft, friable and suitable for smoothing and polishing; as, of metals and fine grained woods.

Rouge.—In mechanics, a polishing material used by jewelers and brass finishers, obtained from "purple ore", which is an almost pure ferric oxide left as residue from the leaching of calcined copper ores.

Rough.—1. Irregular, broken or harsh; crude, raw, unfinished; shaggy; wrinkled in surface: coarse grained or fibered.

2. To perform preliminary operations of manufacture, etc., so as to leave with irregular shape, or a surface covered with ridges; to *rough out*.

Rough Cast.—In building, a coarse plaster, composed of clean gravel and lime, applied to the external walls of buildings, to which the plaster readily adheres.

Rough Coat.—In a foundry, the first coat of loam applied to a *loam pattern*, mould or core.

Rough Cut.—In machinists' work, a first thickness of shaving removed from a piece of metal work in a lathe, shaping or similar machine. The rough cut is taken to penetrate under the skin.

Rough Dimension.—In mechanics it is necessary to give certain allowances of extra thickness of metal in all work which has to be machined, whether castings or forgings, so that they are larger by this amount than the finished dimensions. These are called the rough dimensions, and in the pieces of work, whether rough castings or rough forgings, so long as sufficient thickness is allowed for machining, very close accuracy is not looked for, nor is it necessary.

Rough File.—The coarsest cut given to a file; the other cuts, in order, are *middle cut*, *bastard*, *second cut*, *smooth*, and *dead smooth*.

Roughing Down.—In machinists' work, the removal of the largest bulk of material, including the outer skin or scale, from a piece of work, preparatory to the more accurate and final bringing to shape with *finishing cuts*.

Roughing Drill.—A form of twist drill adapted for speedy working, but producing a rough cut; it has two cutting edges.

Roughing Tool.—In machinists' work, the ordinary tool used by turners and machinists for removing the outer skin, and generally for turning cast iron, wrought iron and steel. It is either of solid cranked form or is a short length of rod held in a cutter bar. Its angles vary with the material upon which it is used.

Roughing Train.—In rolling mill practice, the same as *cogging train*; the series of rolls in which ingots are broken down into rough approximations to their finished appearance, the various sections being rolled true to size and shape in the *finishing train*.

Rough Out.—To bring to an approximate shape by preliminary processes; to bring crudely to shape, size or appearance, by removal of superfluous material; the secondary or finishing processes completing the work.

Rough Surface.—A surface on a casting or forging which has not been machined.

Round.—That which is round; as, a circle, a globe, a sphere.

Round About.—Circuitous; going round; indirect.

Round Bar.—In metals, a bar of iron or other metal. The sections and sizes of rods are variable, *flat*, *round*, *oval*, *half-round*, according to the numerous purposes for which they are required.

Round Buddle.—In mining, a circular concentrating machine for slimes, in which the sediment deposited from the stream of water is strickled or kept smooth by revolving brushes.

Round File.—In tools, a file circular in section. Round files are either tapered or parallel, the tapered files of small size being termed *rat tail* files. Round files are used generally for enlarging holes and shaping hollow curves. Round *parallel* files are also used for gulleting the teeth of large circular and pit saws.

Round Head Bolt.—Two dissimilar shapes for bolt heads, etc., are known by this name; they are:

1. A flat circular head on a bolt with a square neck, used often by builders or carpenters, in fastening wood work.

2. A hemispherical head, employed on bolts and rivets alike. For the sake of difference, the first one is generally known as a *cheese head*, the second as a *snap*, because it is a shape unattainable by direct hammering, but necessitates the use of a snap or die to shape it.

Roundhouse.—On a railroad, a circular shed for locomotives, wherein the engines are cleaned on tracks radiating from a turntable at the center.

Rounding Tool.—In blacksmithing, a *swage tool* hollowed to a semi-cylindrical section and used by smiths for rounding and finishing iron rods.

Round Iron.—Cylindrical bar iron; iron in the rough, before it is turned into shafting.

Round Nose Chisel.—A machinists' hand chisel, forged like a cape or cross cut, but with a semi-circular point, for cutting grooves, dressing out holes, etc.

Round Point Chisel.—A chisel with a conical point, the edge being formed by grinding it obliquely, thus presenting an elliptical cutting face. Used for cutting grooves, etc., in metals.

Rout.—To cut by scooping or gouging; cut away the surface of; deepen; as, with a router. This word is usually used with out; as, *rout out*.

Route.—The course or way which is traveled or passed, or is to be passed; a road or path.

Router Plane.—In carpentry, a plane with a small cranked iron, which is adjustable up or down, thus enabling the tool to smooth the bottoms of grooves, panels, or all other depressions below the general surface. The tool may also be clamped outside its central post, and thus may be used to plane out corners or other inaccessible work.

Routing.—The operation of cutting or routing out a surface.

Routing Machine.—A revolving cutter machine which removes part of a surface and leaves the rest in relief.

Routing Tool.—A rotating steel cutter used for routing in metal; the cutting tool of a routing machine.

Rove.—To draw through an eye or aperture. A copper washer upon which the end of a nail is riveted in boat building. A roll of wool, or sliver, drawn out and slightly twisted preparatory to being further spun into thread or yarn.

Roving.—1. In spinning, the operation of forming the rove, or slightly twisted thread, from the sliver, or roll, of wool, by means of a machine for the purpose, called a roving frame or roving machine.

2. A roll of wool, or sliver, drawn out and slightly twisted; a rove.

Roving Spindle.—An intermediate spindle in cotton spinning, whereby the lap from the carding machine is delivered as a slightly twisted *sliver*.

Row.—1. A series of persons or things arranged in a continued line; a line; a rank; a file.

2. To propel by means of oars; to transport by means of oars or to work at transportation or propulsion by those means.

Rowlock.—A contrivance or arrangement for supporting an oar in rowing. It consists sometimes of a hollow in the gunwale of a boat, sometimes of a pair of pins between which the oar rests on the edge of the gunwale, sometimes of a single pin to which the oar is hooked, or on top of which it is supported, but generally of metal, in the form of a crutch arm end.

Royal Drawing Paper.—In drawing, a sheet of drawing paper of the special size of $24 \times 19\frac{1}{4}$ inches.

Royal Mast.—A light pole, the fourth portion of a ship's mast, which carries the royal.

Royalty.—1. A predetermined rate of payment on coal or minerals raised in a mine, made to the ground landlord or to the government of the country.

2. A fee paid to the author or inventor for the use or reproduction of any literary work, mechanism or process.

Rub.—To clean; to polish; to clean anything by rubbing; to scour.

Rubber.—Caoutchouc or india rubber; made of india rubber.

Rubber Belting.—India rubber interlaid with woven fabric, such as duck or canvas, its *plies* depending upon the number of layers of textile material, made into long strips of various widths and thicknesses for use as belting in transmitting power over pulleys.

Rubber Cement.—A composition of sulphur and caoutchouc dissolved to a paste in benzine or bisulphide of carbon. It is used to cement various pieces together in the manufacture of rubber articles, and in joining belting.

Rubber Cloth.—Cloth coated with india rubber; also india rubber in thin sheets.

Rubbing Board.—In a foundry, a flat board measuring about six inches by three inches, held in the hand and used for sleeking over the flat faces of foundry moulds previous to the final smoothing with the trowel and the blackening.

Rubbing Stone.—1. A flat circular stone of a gritty nature, upon which soft bricks are rubbed to a smooth surface for use in gauged or rubbed bricklaying work.

2. A similar stone used by stonemasons to remove or erase the tool marks on a building stone block.

Rubbing Surfaces.—1. Those parts of a mechanism which move on one another in sliding contact, as opposed to rolling.

2. Moving surfaces in contact with one another, on which wear may take place through friction.

Rubbish.—Waste or rejected matter; anything worthless; especially fragments of building material.

Rubble.—Water worn or rough stones, broken bricks, etc., used in coarse masonry, or to fill up between walls; thin or irregular stones built up without regard to courses.

Rubble Arch.—An arch composed of irregular or broken stone or fragments of stone mingled with cement or clay; when building an arch of rubble stones, care should be taken that they are long and narrow, and roughly dressed to a wedge shape. They should be set in cement mortar, as their stability largely depends upon the mortar.

Rubble Stone.—1. Small stones used for coarse masonry; rubble

2. Conglomerate or pudding stone; rocky fragments cemented together naturally into a stony mass.

Rubble Work.—Masonry executed in rubble; that is, with undressed or uneven sized stones.

Rudder.—That contrivance, developed from an oar at the stern, which controls the course of a vessel; usually a frame, plated over and pivoted on one edge.

Rudder Chains.—Chains whereby the rudder of a ship is secured to either quarter, they being shackled to the rudder just above water line and hanging sufficiently slack to permit free motion. The use of these chains is to prevent the rudder being carried away if it becomes unshipped.

Rudder Frame.—A casting or forging resembling the letter **D** in shape, which is plated over to form a rudder. Smaller rudders are usually cast or forged in one piece.

Rudder Head.—The upper part of the rudder to which the tiller is attached.

Rudder Pendant.—A continuation of the *rudder chains*, being led inboard through a staple or eye; in the event of the tiller or rudder head being carried away, a tackle may be roved through the end of the pendant, thus permitting the ship to be steered.

Rudder Post.—The after portion of the stern frame on which the rudder is pivoted.

Ruffer.—A rude kind of comb used in the first operations of hackling or combing flax by hand. It consists of a tin covered stock of wood with steel or iron teeth, about $\frac{1}{2}$ inch square at the root, and seven inches long. The stock is fastened to a board, set slantwise to the bench, the teeth sloping away from the hackler, who operates by pulling the flax through the teeth with a circular sweep.

Ruffler.—An attachment of a sewing machine to form *ruffles* in the goods.

Rule.—1. A method or maxim; a mode of procedure to be followed in certain circumstances.

2. A method or process in mathematics, whereby a certain desired result may be obtained or operation performed.

3. A graduated wooden or metallic scale or measure, as carried by workmen or others, for purposes of linear measurement; as, a *two foot rule*.

Rule of Three.—A rule by which, when three numbers are given, a fourth number is found, which bears the same relation to the third as the second does to the first; or a fourth number is found bearing the same relation to the third as the first does to the second; also called *proportion*.

Ruler.—An instrument of wood or metal with straight edges or sides, by which lines are drawn on paper, parchment, or other substance; a rule.

Ruling Machine.—A machine by means of which lines are ruled upon blank paper, especially for such as is intended to be made into account books, or the like, requiring many parallel columns. The ruling pens are circular discs with sharp edges, which are threaded at adjustable distances upon a moving shaft, the ink being fed to the revolving discs by means of pads, while the paper travels on a table or web under the pens.

Rumble.—A revolving cask or shaking machine, used to clean small parts of cast iron by mutual friction; called also a *rattler*.

Rumbling Mill.—A drum or cylinder into which castings, etc., are placed with pieces of slag, etc., removing fins, sand, etc., by attrition, as the mill is revolved. Small articles are frequently polished by being passed through a series of rumbling mills, with different abrasive and polishing agents. Also called, *rumbler, rattler, rattle barrel*.

Rummage.—To search or examine thoroughly by looking into every corner, and turning over or removing goods or other things.

Rumsey, James.—Born in Bohemia Manor, Cecil County, Md., 1743; died 1792. In 1784, while engineer in a mill at Shepherdstown, Va., he became interested in Watts' steam engine, and applied it to the propulsion of a boat. In 1784-5, he obtained the exclusive right for steam navigation on the waters of Maryland and Virginia, for a period of ten years. In 1786, he experimented with a steamboat on the Potomac. It was propelled by a jet of water discharged under high pressure at the stern. The Rumsey Society was formed in Philadelphia, to aid him in his experiments, and he went to England, where a similar society was formed to assist him construct an ocean going steamer, but he died there while conducting further experiments. Rumsey, was the author of *A Short Treatise on the Application of Steam*.

Run.—To move or go; as, to hasten; to hurry, also:

1. To melt or fuse; to cause to flow out; to shape by melting or pouring; hence, to cast; as, in a foundry.

2. A passage; as, the run of a steamer.

3. One particular operation; as, a run of a foundry; that is, one casting from the furnace.

Rundel.—1. A circle.

2. A moat with water in it; also, a small stream; a runlet.

Rundle.—A round; a step of a ladder.

Rung.—1. A floor timber in a ship.

2. One of the rounds of a ladder.

3. One of the stakes of a cart; a spar; a heavy staff.

Runlet.—1. In civil engineering, a small stream.

2. In navigation, a small barrel of no certain dimensions. It may contain from 3 to 20 gallons.

Runner.—1. One of the stones of a flouring mill.

2. A rope used to increase the mechanical power of a tackle.

3. In founding, a gate or sprue, more properly the channel conducting the molten metal from one casting to another, when several are cast in the same mould, as with plate moulding. The term is also applied to the metal left connecting the castings together.

4. The fast driving pulley of a pair of fast and loose pulleys.

Runner Head.—In a foundry, the mass of metal which fills the ingate of a foundry mould. Runner heads and feeder heads are knocked off while red hot, and are in request in the foundry for cooling very hot metal just tapped into the ladles. They are dropped in the molten metal, and in becoming remelted, lower the temperature of that in the ladle.

Runner Stick.—In a foundry, a cylindrical or slightly conical piece of wood, which acts as a pattern to form the upright part of the gate. Its point is stuck in the sand of the lower moulding box and the sand of the top part rammed around it. It is withdrawn before lifting the latter.

Running an Engine.—The act or art of attendance upon a prime mover, maintaining it in a proper condition for safe and economical running, seeing that all parts are properly lubricated while in motion, and making such repairs and adjustments as are necessary for its best efficiency. By extension, the care of the engine includes care for the boiler or other means of producing the working fluid, the greatest responsibility of an attendant being to maintain a proper water level in the boiler. The processes of keeping internal surfaces free from scale, heating surfaces clean from soot, together with the adoption of economical methods of firing, prompt repair of small leaks, avoidance of corrosion, straining by rapid steam raising, and waste of steam by blowing off, all mark the careful engineer of a steam plant.

Running Away.—In a foundry, the escape of metal from a mould in the act of pouring, due to bad jointing of the sand. When it occurs in quantity, a *waster casting* results.

Running Board.—A narrow platform extending along the side of a locomotive.

Running Down.—In a foundry, the melting of iron in a cupola. When a charge of iron is melted and completely liquid at the tap hole, it is said to be *run down*. A definite charge takes a definite time to run down, the time being variable with the character of the cupola and the nature of the fuel and the blast, but is constant for the same cupola.

Running Fit.—That fit in practical mechanics where one part will run indefinitely in another when lubricated, the amount of difference between the male and the female part depending upon the class of the work. Thus, for a 2 inch shaft, the hole would be bored from .0015 to .0035 inch larger, the latter size giving a very easy fit.

Running Gear.—The wheels, axles and frames of a vehicle.

Running In.—In steam engineering, an engine is said to *run in* when the valve is so set that the top of the fly wheel rim runs towards the cylinder.

Running Out.—1. In metal work, the slipping or working of a drill to one side of the center in which it was started, due to carelessness in centering, or to improper setting of the work, or to a badly formed drill, or to the influence of inequalities on the surface of the work itself. It is remedied by recentering with the center punch if the hole is not entered deeply, and by chipping out if it is too deep for punching. If very deep, the evil is incapable of remedy except by filling or broaching, or boring or drifting, according to circumstances.
2. In turning, when a piece of work is not chucked truly in a lathe, but is eccentric.

Running Over.—In steam engineering, an engine is said to *run over* when the valve is so set that the top of the fly wheel rim runs away from the cylinder.

Running Shed.—The roundhouse, stable, or shed wherein locomotives are cleaned, prepared for service, and such light repairs are carried on as are necessary for their continued operation.

Running Under.—In steam engineering, an engine is said to *run under* when the valve is so set that the bottom of the fly wheel rim runs away from the cylinder.

Run Out.—In iron working, a term sometimes applied to a finery or refinery for pig iron, so called because the oxidized pig is run out over water cooled cast iron troughs, where it hardens into thin plates which are broken up for puddling.

Runover.—1. To overflow; as, a cup runs over.

2. To go over, or to examine; as, an outfit to see that nothing is lacking.

Runway.—1. The channel or bed of a stream.

2. The elevated tracks for traveling cranes, hoists, and parcel carriers.

3. In lumbering, an incline down which logs are slid; as, to a stream.

4. A groove in which a window sash slides.

Rupture.—A tearing apart; breaking.

Russia Iron.—A special kind of sheet iron manufactured in Russia, and used

for lagging engines, boilers, etc. It is made by a secret process, which produces an iron which has a very hard and highly polished surface, thus rendering it easy to keep clean. A similar material is produced elsewhere under the name of *planished iron*.

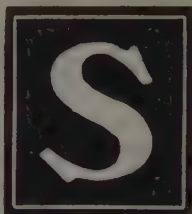
Russia Leather.—A leather originally made in Russia from the skins of calves, but now made elsewhere as well, and from goat and sheepskins, also. It is tanned like other light leathers, being *puered* after un-hairing and tanned with the softer materials, but is afterwards treated on the flesh side with an essential oil distilled from birch bark and buds, giving it its characteristic odor.

Rust.—The reddish or brownish yellow coating on iron exposed to moist air; an

oxide of iron which forms a rough coat on its surface.

Rust Joint.—A joint employed by engineers where it is necessary to withstand high water pressure, the joint being filled with a paste which oxidizes the iron, the whole rusting together and hardening into a solid mass. A good recipe is 80 lbs. cast iron borings or filings, 1 lb. sal ammoniac, 2 lbs. flowers of sulphur, mixed to a paste with water.

Rut.—The grooved track left by the wheels of vehicles in soft ground, in which one cart follows another. Hence, figuratively, a narrow or restricted manner of life in which it passes, as along a rut, without break or deviation.



S.—The nineteenth letter of the English alphabet. The suffix (or added letter), used to form the plural of most words; as, roads, machines, etc.

Sabica Wood.—The very heavy dark colored wood of a large Cuban tree, prized in shipbuilding for hardness and durability. Called also *horse flesh mahogany*.

Saccharimeter.—An optical instrument, depending upon the *polarization of light*, for ascertaining the strength of sugar or sugary solutions; a *polariscope*. Solutions of cane sugar, milk sugar, maltose and glucose, twist a ray of polarized light to the right, or are *dextrorotatory*; fruit sugar, or invert sugar, turns the ray to the left, or is *levorotatory*, hence its name *invert*. The amount or angle of the twist depends upon the strength of the solutions observed, hence, this is a certain means of determining the quality and composition of sugars.

Saccharin.—A white crystalline compound, 300 times sweeter than cane sugar. It is used as a substitute by persons who cannot eat sugar. Saccharin is derived from *toluene*, a constituent of coal tar.

Saccharine.—Sweet; of or pertaining to sugar; having the taste and other qualities of sugar.

Saccharometer.—A variety of *hydrometer* whereby may be determined the density and consequently the amount of sugar in brewers' worts or other saccharine solutions.

Saccharose.—Cane sugar, as obtained from sugar cane, maple, beet, etc., and deviating the plane of polarized light to the right.

Sack.—A bag or pouch, more commonly a large bag of coarse hempen cloth for holding odd tools, etc.

Sacking Spout.—A spout to which sacks are attached, in order to fill them with flour or grain from a mill or elevator.

Saddle.—In mechanics, something resembling a saddle in form, use, or the like; as, a part to sustain or secure another

part upon a curved surface. The name is given also to other pieces of wood hollowed out; as, the saddle of a bowsprit.

Saddle Back.—1. In a return tube boiler, the curve of the flue to meet the combustion chamber tube plate.

2. The throat plate.

3. A forked self-trimming coal bunker.

Saddle Back Coping.—A coping of a wall or parapet, whose top slopes in two directions from the center.

Saddle Back Joint.—A joint used in weathered masonry surfaces to prevent water from soaking in, this being effected by sloping the work away on either side from the joint, so that the water will run off.

Saddle Flange.—In pipe fitting, a curved flange hollowed out to fit a boiler, a pipe or other cylindrical vessel.

Saddle Key.—In machinery, a key whose inner face is hollowed to fit its shaft, instead of the shaft being either flattened or recessed for its reception, as is the case with ordinary keys.

Saddlers' Punch.—An annular cutting instrument wherewith holes are made in leather, the material being cut out in a neat circular or oval disc, without tearing or breaking.

Saddlery.—1. The materials for making saddles and harnesses; the articles usually offered for sale in a saddlers' shop.

2. The trade or employment of a saddler.

Saddle Shaped.—1. In civil engineering, bent on each side of a mountain or ridge, without being broken at the top; said of a strata.

2. In mechanics, shaped like a saddle, or bent down at the sides so as to give the upper part a rounded form.

Saddle Tank.—A water tank fitting over the boiler barrel of a locomotive, and shaped as a saddle.

Saddle Tank Engine.—In railway engineering, a locomotive engine in which the water tank envelopes the top and sides of the boiler, thus presenting the appearance of a *saddle*.

Sad Iron.—An instrument for smoothing or ironing cloths; a flat iron.

Safe.—A place of deposit for valuables, usually a large steel box or closet, provided with hard walls and an intricate locking mechanism, and furnished with a compartment containing a preservative compound which is liberated by the heat of fire and protects the contents against burning.

Safe Edge.—An uncut edge on a file; an edge presenting a smooth surface, without teeth, so that the file may be used in a corner and cut on one surface only.

Safeguard.—In railway engineering, an axle guard to keep the car wheels on the track at a switch.

Safe Internal Pressure.—The safe internal pressure on cylindrical shells is found according to the following rule, which has been adopted by the United States Board of Supervising Inspectors, and any boiler shell can be determined by this rule: Multiply one sixth of the lowest tensile strength found stamped on any plate in the cylindrical shell by the thickness expressed in inches or parts of an inch of the thinnest plate in the same cylindrical shell, and divide by the radius of half diameter, also expressed in inches, and the result will be the pressure allowable per square inch of surface for single riveting, to which add twenty per cent. for double riveting.

Safe Load.—The amount of loading or of force which may be borne without risk by a structure, or by any one of its members. Not only should the safe load be but a fraction of the ultimate strength of the piece, but it should also lie well within the elastic limit of the material.

Safety.—1. The condition or state of being safe; exemption from hurt, injury, or loss.

2. The quality of making safe or secure.

Safety Arch.—In building, an arch formed in the body of a wall, as over a door or window, to distribute and relieve the pressure.

Safety Belt.—A belt capable of being inflated, or made of some buoyant material, to enable a person to float in water; a life preserver.

Safety Buoy.—In navigation, a float to be attached to the person to prevent drowning.

Safety Cage.—In mining, a cage provided with safety catches to prevent its falling, and a detaching hook to prevent over winding.

Safety Catch.—In elevator construction, a device working by powerful springs, relieving stops on the bottom of an elevator car which grasp the *guides*, as soon as the speed of descent becomes too great for safety by breaking of the cable or other causes.

Safety Chains.—Side chains or links fitted between a locomotive and its tender, as a precautionary measure in case of the drawbar failing.

Safety Factor.—The number of times the ultimate or breaking strength of the material or structure is designed to exceed the strains to which anything is put in ordinary circumstances. The safety factor varies greatly, depending on the nature of the load and the material used in construction. Also called *factor of safety*.

Safety Hoist.—In machinery, any hoist constructed with differential pulleys. Also an ordinary rope hoist in which an automatic catch or *safety stop* secures the apparatus against running down.

Safety Ladle.—In a foundry, the tipping of a heavy ladle, for the purpose of pouring its contents into a mould, was formerly effected by power of men, applied to levers fixed on the axis of its trunnions. To obviate the risks attendant upon this clumsy method, Nasmyth applied the screw and worm wheel movement thereto. One man, by turning a handle affixed to a worm and screw shaft, can then move several tons of metal with ease. This is called the *safety ladle*. Geared ladles of larger sizes are often provided with a pair of mitre wheels in addition to the worm gear, by which more power is gained.

Safety Lamp.—In mining, one in which the flame is protected by a shade or screen of finely woven wire cloth from contact with dangerous inflammable gases in the surrounding atmosphere.

Safety Match.—A lucifer match having no phosphorus in its composition. The tip is composed of a mixture of potassium chlorate, red lead, and black sulphide of antimony. The phosphorus used, is in the allotropic or red amorphous form, and is stuck on the side of the box with glue. When the safety match is struck on this compound, a portion of the amorphous phosphorus is rubbed off, adheres to the tip of the match, and causes it to catch fire.

Safety Nut.—A lock nut, as placed on a bolt subjected to vibration, so that the ordinary nut may not slack back.

Safety Plug.—A hollow plug, filled with a lead tin alloy, which melts at a point slightly above the temperature of the steam in a boiler. Such plugs are screwed into various places; such as, the fire box crown or the roof of the combustion chamber, and are designed to melt if the water runs low, thus putting out the fire and preventing over heating of the plates. Also known as *fusible plug*.

Safety Relief Valve.—In steam engineering, a valve which automatically prevents the steam pressure in the low pressure cylinder of a multi-cylinder engine from rising above an assigned pressure, so that the cylinder will not be unduly strained if high pressure steam be admitted through the bypass valve; as, in starting.

Safety Stop.—A device fitted to many stationary engines, whereby the engine is stopped automatically should anything happen to the governor. Electrical devices are fitted to the engines of some large plants, whereby the engine may be stopped, in case of accident, from various points on the premises; the apparatus is placed in a glass fronted box, like a fire alarm, to protect it.

Safety Switch.—A railway switch or points so arranged that a train cannot be thrown off the rails if it be set right or wrong.

Safety Valve.—1. A circular valve seated on the top of a steam boiler, and weighted to such an extent, that when the pressure of the steam exceeds a certain point, the valve is lifted from its seating and allows the steam to escape. Safety valves may be loaded directly with weights, or the load may be transmitted to the valve by a lever. Again, the end of the lever is sometimes held down by a spring, or the spring may be applied directly to the valve seat.

2. In locomotives and steamships, the valves are spring loaded, on account of oscillation and vibration, which render weighted valves useless. Ferryboats and other craft plying on still waters are sometimes fitted with weighted valves.

Safety Valve Lever.—In steam engineering, the lever of a safety valve on which the weight is suspended. This is a *third class lever* because the power or steam pressure is between the fulcrum and the weight.

Safety Valve Spindle.—The small rod which projects upward or downward from the middle of the valve, and so arranged that it causes the valve to raise and drop evenly upon its seat.

Sag.—1. To cause to bend downward in the middle; to lean, incline, bend, hang away, in consequence of unsupported or insufficiently supported weight; to settle; to give way; to yield; as, a door sags, or a beam sags by means of its weight.

2. In navigation, to drift to leeward; as, the leeward drift of a vessel in tacking.

Sagger.—1. A rough earthenware tray or box, in which pottery is placed in the kiln to be burned. The base of one sagger serves as the lid of the next beneath as they are stacked in piles.

2. A similar vessel in which foundry cores are placed in the core oven for drying. Also written *saggar*, or *seggur*.

Sag of Belt.—In millwrighting, in the location of shafts that are to be connected with each other by belts, care should be taken to secure a proper distance, one from the other. This distance should be such as to allow of a gentle sag to the belt when in motion. A general rule may be stated thus: Where narrow belts are to be run over small pulleys, 15 feet is a good average, the belt having a sag of 1½ to 2 inches. For larger belts working on large pulleys, the distance should be 25 to 30 feet, the belts working well with a sag of 4 to 5 inches. If too great a distance is attempted the belt will have an unsteady flapping motion, which will destroy both the belt and machinery.

Sail.—1. Anything spread to catch the wind.

2. A canvas cloth extended on a yard, gaff or stay, whereby a vessel is propelled through water by the force of the wind. Sails which are extended on yards transverse to the center line of the ship, are known as *square sails*; those stretched on gaffs as well as the triangular canvases, termed jibs and staysails, are known as *fore and aft sails*.

3. A vane of a windmill; one of its radial arms, furnished with movable slats, whereby its area is increased or diminished, according to the angle at which they are set.

Sail Cloth.—Duck or canvas used in making sails.

Sailing Ship.—A term applied to vessels which are propelled solely by the power of the wind upon their sails.

Sailmaker.—An artificer who is carried on shipboard for repairs and making of sails, awnings and other canvas work.

Sailor.—A name given to one following the sea. More properly *seaman*; a mariner.

Sakieh.—In hydraulics, a rude water-raising device, formerly used in Egypt, having a wheel or wheel and chain,

carrying pots or buckets, and mechanism for operation by draft animals, usually oxen.

Sal.—A prefix meaning *salt*, used in connection with the colloquial names for such chemicals as *sal ammoniac* (ammonium chloride), *sal volatile* (ammonium carbonate) *sal soda* (sodium carbonate).

Salamander.—In a foundry, a mechanical obstruction in a furnace due to one, two or several causes in combination; as, bad fuel, slag, bad charging or a badly shaped furnace.

Sal ammoniac.—Ammonium chloride, chiefly obtained by distillation of the ammoniacal liquor of gas works, neutralization with hydrochloric acid, and concentration of the liquid by evaporation until crystals are formed. The chloride is very soluble in water, and is much used as a chemical reagent and in shop processes.

Salary.—Fixed regular wages; as, by the year, quarter or month, for services; as, the salary of a foreman.

Sales Account.—A formal statement of things sold, giving the gross amount from which is taken expenses incurred and commissions, leaving the *net proceeds* of the transaction.

Salesman.—One who sells anything; a machinery salesman; as, one who sells engines, pumps, belting, oil and supplies.

Salicylic Acid.—In chemistry, an acid formerly obtained by fusing salicin with potassium hydroxide, but later made in quantities from phenol, carbolic acid, by the action of carbon dioxide on heated sodium phenolate. It is a white crystalline substance; used as an *antiseptic*.

Salient.—In mathematics, projecting outwardly; as, a salient angle; opposed to re-entering.

Saline.—Containing salt or consisting of salt; as, saline substances.

Salinometer.—A glass or metal instrument by which the density of salt water is ascertained. It consists of a weighted bulb, to which is attached a graduated stem, and its action is to indicate the amount of salt held in solution in the water, by floating higher or lower; higher for density, lower for freshness. Some are graduated into 32nds and some to 32nds, each representing about five ounces of

salt to a gallon of water. Care must be taken to use the salinometer at the temperature for which it is marked, as the densities of fluids vary in proportion to their temperature.

Salometer.—In refrigeration, a species of hydrometer or salinometer used to test the density of the brine solution. It is graduated so that four degrees on the salometer correspond to each one per cent. in a solution of sodium chloride, at a temperature of 60° Fahr.; thus, 70° of saltiness would correspond to a solution having a strength of 17½ per cent. When used for calcium chloride brine, the salometer shows a reading nearly one tenth larger for equal percentages of strength.

Salt Soda.—In chemistry, a white crystalline substance, having a cooling alkaline taste. It is found in the ashes of many plants and produced artificially in large quantities from common salt. It is used in making soap, glass, paper, etc., and as an alkaline agent in many chemical industries.

Salt.—1. In chemistry, the neutral compound formed by the union of an acid and a base; thus, sulphuric acid and iron form the salt of sulphate of iron or *green vitriol*.

2. The chloride of sodium, a substance used for seasoning food, for the preservation of meat, fish, etc. It is found native in the earth, and is also produced by evaporation and crystallization from sea water and other water impregnated with saline particles.

3. In civil engineering, marshes flooded by the tide.

4. In navigation, a sailor; usually qualified by old.

Salt Block.—A salt factory; an apparatus for evaporating brine.

Salt Cake.—In chemistry, the white caked mass consisting of sodium sulphate, which is obtained as the product of the first stage in the manufacture of soda, according to Leblanc's process.

Saltern.—Salt works; a building in which salt is made by boiling or evaporation.

Salting.—In marine engineering, the accumulation of a deposit of salt on the plates of a marine boiler. A certain amount of salting is not injurious to the plates, but the density of the water should not exceed $\frac{1}{16}$, or from eight to ten ounces of salt to a gallon.

Saltpetre.—A salt consisting of nitric acid and potassa; nitrate of potassa; also called *niter*.

Salt Pit.—A pit where salt is obtained or made.

Salts of Sorrel.—Crystals of oxalic acid combined with an acid potassium oxalate. It is a violent irritant poison, its antidote being chalk or lime water. It is chiefly used in dyeing, calico printing, for removing ink stains from linen, and in the bleaching of flax and straw. Also called *essential salt of lemon*.

Salt Water.—Sea water; water containing in solution chloride of sodium, calcium sulphate, with magnesium and other salts, the total mineral matter forming on the average, about 3 per cent. of the whole weight.

Salvage.—A compensation or allowance paid to salvors, or those by whom a vessel has been saved from loss at sea. The amount depends upon the circumstances of the case, the value of the vessel salvaged and the services actually rendered. The amount being determined by the judge or assessor, it is usually divided as follows: $\frac{1}{2}$ to the owners of the salvaging vessel, $\frac{1}{4}$ of the remainder to her master, and the remaining $\frac{1}{4}$ to be divided between her officers and crew, according to their rating.

Salve.—1. A soothing remedy or antidote; an adhesive composition or substance to be applied to wounds and sores; a healing ointment.

2. A sea term, to aid or succor; to preserve or save from loss, destruction or great damage, especially at sea.

Sammier.—In tanning, a machine for pressing the water from skins, in the process of making leather.

Samovar.—A metal urn used in Russia for making tea. It is filled with water, which is heated by charcoal placed in a pipe, with chimney attached, which passes through the urn.

Sampan.—A Chinese boat from twelve to fifteen feet long, sometimes used as a permanent habitation.

Sample.—A part of anything presented for inspection or intended to be shown as an evidence of the quality of the whole; a specimen.

Sampling.—In metallurgy, the process of judging of the quality of pig iron or steel by the appearance of a newly fractured surface. A small button of metal is removed from the surface and either flattened out or broken with a sledge, and by the appearance of the fracture or by a ready chemical test, or both combined, the properties of the metal are inferred and any necessary alteration made in the proportions of the ingredients, or in the conditions of working.

Samson Post.—In well boring, the upright member or post that supports the walking beam.

Sand.—Fine particles of stone not yet reduced to powder or dust; very small pebbles.

Sand Bank.—In a foundry, where small pipes are cast in quantities, the moulding boxes are placed and the metal run on a bank of sand sloping at an angle of about 45 degrees. The pipes are sounder when made by this method than horizontally, since the *sullage* rises to the upper portion, as is the case when the casting is upright.

Sand Bed.—The bed of sand constituting the *pig bed* of a blast furnace.

Sand Bending.—The process of bending lead or other pipes after having first filled them with sand and plugged the ends.

Sand Bin.—In a foundry, a trough or compartment used as a convenient receptacle for the sand required for the use of the moulder, the different sands being kept in separate bins.

Sand Blast.—An apparatus whereby fine sand is blown in any desired direction by a powerful jet of compressed air. Used for removing superfluous spelter from brazed joints, cleaning metallic surfaces that require enameling, dressing file-teeth, and manifold other uses.

Sand Blast Sharpening.—In file making, the sharpening of files by the direction of a current of sand and water across the teeth and along the file at an angle. The mixed current is discharged by the introduction of a steam jet. The sand is as fine as flour emery. Files sharpened thus are considered superior to those out in the ordinary manner.

Sand Box.—A box with a perforated top or cover, for sprinkling paper with sand; also, in locomotives, a box from which sand is sprinkled on the rails in front of the driving wheels, to increase their adhesion, etc.

Sand Cranes.—Used to hoist sand for filling the boxes on a locomotive.

Sand Dune.—A hill of wind blown sand, usually bound together by long tough grasses, such as grow in a salt atmosphere. Such dunes are formed from the sea sand, by the action of wind and water, in many parts of the world.

Sand Finish.—A rough finish given to plastering, the third coat being mixed with lime putty and coarse sand. This is applied before the brown coat is quite dry and should be applied with clear, soft pine or cork faced floats.

Sand Line.—In well boring, a wire line used to lower and raise the boiler or sand pump, which frees the bore hole from cuttings.

Sanding Machine.—A machine having wheels, or rollers covered with sand-paper and used for finishing woodwork.

Sand Moulding.—The art or process of forming moulds from sand, usually by ramming it into flasks upon a wooden or metallic pattern; as contrasted with loam moulding, in which the moulds are built up of brick, etc., and faced with a compost or loam, which is trued to a surface by means of sweeps and the like.

Sandpaper.—Paper covered on one side with a fine, gritty substance and used for smoothing and polishing.

Sandpapering Machine.—A machine having rotary cylinders covered with sand or glass paper, which put a polished surface on planks passed between them.

Sand Pipe.—In a locomotive, the pipe leading from the sand box to the rail, used for the purpose of distributing sand to aid the adhesion of the wheels on the track.

Sand Plug.—In a foundry, a sand or clay plug is a term applied to the ball of sand or clay with which the riser of a mould is covered, while the metal is being poured at the ingate. Its purpose is to check the too rapid rushing of the air out of the mould before the advancing metal, which would be liable to result in a washing away of some portions of the sand. The plug is either floated up by the rise of the metal, or more properly, the moulder removes it when he sees that the mould is nearly full.

Sand Pump.—In well boring, a pump consisting of one length of tubing or two lengths jointed together, and provided with a non-return valve in the bottom, which is lowered into a bore-hole to remove water and cuttings therefrom.

Sand Reel.—In well boring, the spool or drum on which is wound the sand line.

Sand Ring.—An angle bar fastened around the outside of a heating fur-

nace, to serve as support for a lagging or clothing of sand, loam, etc.

Sand Sifter.—In a foundry, a machine made for sifting sand, worked by hand or power. For sifting sand in small quantities sieves or riddles are employed. There are different forms of machines, small sifters resting on supports, larger ones being suspended from suitable beams.

Sandstone.—A rock made of sand, more or less firmly united. Silicious sandstone consists mainly of quartz sand; but, if very hard, it is often called *grit*. Granitic sandstone consists of granitic sand; argillaceous sandstone contains much clay.

Sand Trap.—In paper making, a shallow box with transverse partitions, like the riffles of a miners' sluice box, over which the pulp flows from the supply to the paper machine, heavy impurities such as sand being collected by the partitions. Also called *sand table*.

Sand Valve.—In railway engineering, the valve by which the escape of sand from the sand box of a locomotive is regulated. It is under the control of the driver, being actuated by a special lever.

Sanitary Engineer.—An engineer whose vocation is sanitation, the construction or inspection of buildings, drainage and sewage systems, water supply, plumbing, and other needs of the physical well being of communities.

Sanitary Pump.—In steamers, a separate or independent salt water pump for closets, baths, and washing down generally.

Sanitation.—The science of hygiene; the study and adoption of measures, methods and appliances whereby the health of individuals and communities may be safeguarded and assured.

Santorio (Santori).—An eminent physician, born 1561, at Capo d'Istria; died at Venice, 1636. He studied at Padua. After having practiced medicine for some years at Venice, he was invited in 1611 to the first theoretical chair at Padua, and there commenced a series of observations on insensible perspiration, which made his name famous throughout Europe. He appears to be the first who thought of applying the thermometer and hygrometer to medical purposes. An instrument for exhibiting differences in the pulse is attributed to him, also various other contrivances for surgical uses, to which he was led by his mechanical genius.

Santos-Dumont, Alberto.—Born 1873.

A Brazilian aeronaut of French descent. He early developed a passion for aerial navigation, and made many experiments with cigar shaped balloons of his own design, which could be guided, controlled, and propelled with a measure of success. In 1901, he circled the Eiffel Tower in Paris, in one of his air ships, thereby winning a prize of 100,000 francs. His courage, persistence, and ingenuity have been productive of results which give promise of ultimate success in a most difficult field of mechanical operations.

Sap.—The juice of plants of any kind, especially the ascending and descending juices essential to nutrition.

Sapping Machine.—A circular saw, mounted on a proper bench, by means of which the sapwood is removed from a log of timber, in preparing the *bolt* from which roofing shingles, etc., are subsequently sawed.

Sappy.—In civil engineering, timber is said to be sappy, when there is an excessive proportion of green *sapwood* present in it, or when it has not been properly seasoned, so that the sap remains in large quantities.

Sapwood.—In timber, the wood which lies immediately underneath the bark of a tree. It is of inferior value, and rapidly undergoes deterioration when in the plank.

Sarking.—In carpentry, thin boards for sheathing, as above the rafters and under the shingles or slate, and for similar purposes.

Sash.—The frame of a window in which the lights or panes of glass are set.

Sash Balance.—A spring device for balancing window sashes, replacing the weights and pulleys by a coiled clock spring which sustains the weight of the sash. This device is useful where there is no space to insert the ordinary weights.

Sash Chain.—A chain, usually composed of flat weldless links or else of riveted plates or small eyebars, used to support heavy window sashes. For medium sashes a steel or aluminum bronze *ribbon* is frequently employed.

Sash Cord.—A cord by means of which the balance weights are connected to window sashes, usually laid up of cotton or linen.

Sash Pulley.—In carpentry, the sheave in the pulley piece of a sash frame over which the weight cord runs. The sheave is held between two plates, which have counter projections and depressions on the edges of their incurved ends, and side perforations for reception of the sheave pivots.

Sash Weight.—A weight used to counterbalance the movable sashes of a window through a cord running over a pulley in the window case. The usual type of weight is a cast iron cylinder about 1½" diameter, of varying length to suit light or heavy sashes, an eye being formed in one end of the casting for connecting the cord.

Satin Wood.—The hard lemon colored wood of an East Indian tree. It takes a lustrous finish and is used in cabinet work.

Satisfaction.—The act of satisfying; settlement of a claim, due or demanded.

Saturated Seawater.—Salt water brine that has been concentrated by evaporation until salt begins to crystallize out; the saturation point is reached theoretically at about 12 times the density of ordinary sea water, but in practice it occurs much earlier.

Saturated Solution.—A solution which, at the given temperature or other modifying conditions, cannot be made to dissolve or absorb more of the given substance than it already contains.

Saturated Steam.—A quantity of loosely held vapor or steam produced over, or in communication with, the water of a steam boiler and held in suspension; this expression denotes the regular condition of steam formed over water, and that such steam stands both at the condensing point and at the generating point. The temperature of saturated steam depends on its pressure.

Saturation.—In steam engineering, a vapor is said to be saturated when it has a *temperature* due to its *pressure*. It then holds a quantity of moisture in suspension and is not in the condition of a true gas. Also called *dry steam* and *saturated steam*.

Saturation Plant.—In beet sugar manufacture, the apparatus wherein the diffused juice of the beet chips has milk of

lime added to it, and is then treated with carbon dioxide while heat is applied. This precipitates many of the impurities and sends up a scum. The clear liquor is decanted and subjected to a second similar process, *double carbonation*, after which it is saturated with sulphurous acid gas, which deposits the lime as sulphide and exerts a powerful bleaching effect upon the juice. The clear liquor is afterwards evaporated similarly to cane sugar.

Saturation Point.—When a solvent is unable to take up any more of the substance in solution, it is said to be at the saturation point. Thus, air reaches the saturation point when it can absorb no more moisture; any vapor becomes saturated at the maximum density and pressure corresponding to its temperature; brine is said to be saturated when it can dissolve no more salt.

Save All.—Anything which saves fragments, or prevents waste or loss, as:

1. A small sail sometimes set under the foot of another sail to catch the wind that would escape under it.

2. In paper making, a tray or trough under the tube rolls, supporting the traveling wire of the paper machine, which receives the water falling out of the pulp, and returns it for mixing afresh with the pulp.

Savery, Thomas.—Born 1650, died 1715. An English engineer and inventor. He invented a machine for polishing plate glass (1696), and the same year, a method of propelling boats by means of paddle wheels worked by a capstan; but his chief distinction is due to the invention of a pumping engine, involving the application of steam power (1698), which as later developed by himself and Newcomen, proved of considerable practical value.

Saw.—1. An instrument for cutting or dividing substances; as, wood, iron, etc., consisting of a thin blade or plate of steel, with a series of sharp teeth on one edge, which remove successive portions of the material by cutting or tearing.

2. To form by cutting with a saw; as, to saw timber into boards or planks.

Saw Arbor.—The mandrel or shaft on which a circular saw revolves.

Saw Bench.—The table or mounting for a circular saw.

Sawdust.—Dust or small fragments of wood, or other material, made by the attrition of a saw.

Sawdust Conveyers.—Conduits whereby suction fans, worm conveyers, etc., remove sawdust and chips from wood-working plants, usually to furnaces where they may be burned.

Saw Files.—In tools, files made especially for the use of the saw sharpener, though employed also for other work. They are

known under various names, and made in various classes, mostly as *second cut* and *smooth*, and both *single cut* and *double cut*. They are either *taper files* or *blunt files*, and of great range regarding lengths. For saws having triangular teeth simply, the ordinary triangular single cut taper files are used, but for circular and pit, and large frame saws, the parallel, blunt, double cut, flat faced, round edged files are employed.

Saw File Temper.—A temper of steel, according to the manufacturers classification, which contains $1\frac{1}{2}$ per cent. of carbon. It hardens well, and tools made of it take a very fine edge; it is easier to work than razor temper steel, but is difficult to weld.

Saw Filing Machine.—In mill work, a machine used for filing bandsaws in which the file is carried to and fro by an arm provided with a rectilinear motion, at the same time that the saw is traversed along a distance equal to a single tooth for each traverse of the file.

Saw Gin.—The form of cotton gin invented by Eli Whitney, in which the cotton fibers are drawn, by the teeth of a set of revolving circular saws, through a wire grating which is too fine for the seeds to pass.

Saw Gullet.—In mill work, the curved bottom or root or interspace between contiguous saw teeth. The teeth of the larger saws alone are gulletted, the object being to secure freedom or clearance for the sawdust without choking the saw or causing it to work hard. Gulletting, called also saw gumming, is only performed once to every two or three times of sharpening.

Saw Gumming.—In mill work, the grinding out of the *gullets* or roots of circular saw teeth by means of emery wheels, the sections of whose edges are the counterparts of the tooth spaces.

Sawhorse.—1. A kind of rack, shaped like a double St. Andrew's cross, on which sticks of wood are laid for sawing by hand; called also *backsaw* and *sawback*.

2. A trestle, used by woodworkers, for supporting one end of a plank which they are sawing; also for supporting the planks, over a saw pit, upon which the sawyer stands.

Sawmill.—A mill for sawing, especially for sawing timber.

Saw Packing.—Plaited hemp packed on each side of a circular saw, to warm it and equalize its tension when running.

Saw Set.—An instrument used to set or turn the teeth of a saw a little outward, that they may make a kerf somewhat wider than the thickness of the blade, to prevent clogging or friction.

Saw Sharpening.—In mill work, the bringing of the teeth of saws to a keen edge when dulled by use. It is effected by files, mostly worked by hand. The sharpening is done from each side of the blade, every alternate tooth being filed from one side, and afterwards all the intermediate teeth from the side opposite, the teeth being filed in the same direction in which they lean, both to prevent screeching of the saw, and to give a burr on the cutting edge. For sharpening small saws, a single triangular file is used; for large saws, a flat file having rounded edges for gulleting.

Saw Spindle.—In saw milling, the spindle which carries a circular saw. It consists of a turned spindle furnished with bearing necks, fast and loose pulleys, and a couple of washers, one fixed, the other movable and tightened with a nut, the saw being clamped between the two washers and prevented from turning by a feather fitting into a slot cut in the hole in the center of the saw.

Saw Teeth.—In sawing, the angles of saw teeth vary with the work they have to do. The angles of the faces are from 80° to 85° for hard, 65° to 70° for soft wood, and the relief angle is 65° to 70° for hard, 45° to 50° for soft wood. The spacing and the set should be greater for soft than for hard wood. For cross cutting, the teeth are set farther back than for ripping.

Saw Tooth Roof.—One whose sides are made unequal with slopes. The short, nearly vertical slope is glazed, and faces the point whence the most sunlight may be expected, the long flat slope is better calculated to withstand the pressure of snow or wind, and the light is not obscured by snow. Also called *weaving shed roof*.

Sawyer.—1. One whose occupation is to saw timber into planks or boards.

2. A tree which, being undermined by a current of water, and falling into the stream lies fast by the roots, with its branches rocking above and below the surface of the water, with the fluctuations of the current of the stream, from which motion the name is derived.

Scab.—In foundry, a defect on the outside of a casting, caused by a portion of the sand having been washed up by the fluid metal, and forming a spongy lump.

Scabbling.—A fragment or chip of stone; written also, *scabbling*.

Scabbling Hammer.—A very heavy stonemasons' hammer, weighing about 22 lbs., employed in dressing granite,

etc.; it is used for knocking off the larger lumps and reducing the blocks approximately to shape. Occasionally the scabbling hammer is employed to dress the exposed face in *hammer dressed* work.

Scaffold Boards.—Planks used to form the flooring of a bricklayers' or masons' scaffold. They are usually 12 feet long, 9" wide, $1\frac{1}{2}$ " thick, with their ends protected against splitting by hoop iron strips, while they also have a protected hole through which the rope's end may be passed when hoisting them.

Scaffolding.—A temporary structure of timber, boards, etc., for various purposes; as, for supporting workmen and materials in building, etc.

Scald.—To burn with hot liquid or steam; to pain or injure by contact with, or immersion in, any hot fluid; as, to scald the hand.

In severe cases of burns or scalds the clothes should be removed with the greatest care; they should be carefully cut, at the seams, and not pulled off. In scalding by boiling water or steam, cold water should be plentifully poured over the person and clothes, and the patient then be carried to a warm room, laid on the floor or a table but not put to bed, as there it becomes difficult to attend further to the injuries. The secret of the treatment is to avoid chafing, and to keep out the air. Save the skin unbroken, if possible, taking care not to break the blisters; after removal of the clothing an application to the injured surface of a mixture of soot and lard is, according to practical experience, an excellent and efficient remedy. The following method of treatment is recommended:

Take ice well crushed or scraped as dry as possible, then mix it with fresh lard until a broken paste is formed; the mass should be put in a thin cambric bag, laid upon the burn or scald and replaced as required. So long as the ice and lard are melting there is no pain from the burn; return of pain calls for a repetition of the remedy.

A method in use in the N. Y. City Hospital, known as the "glue burn mixture," is composed as follows: $\frac{7}{8}$ troy ozs. white glue, 16 fluid ozs. water, 1 fluid oz. glycerin, 2 fluid drachms carbolic acid. Soak the glue in the water until it is soft, then heat on a water bath until melted; add the glycerin and carbolic acid and continue heating until, in the intervals of stirring, a glossy strong skin begins to form over the surface. Pour the mass into small jars, cover with paraffin papers and tin foil before the lid of the jar is put on and afterwards protect by paper pasted round the edge of the lid. In this manner the mixture may be preserved indefinitely.

When wanted for use, heat in a water bath and apply with a flat brush over the burned part.

Scale.—1. Incrustation within a vessel occasioned by mineral matters deposited from water, etc.; as, the scale in a boiler.

2. To peel off in flakes, either by natural process, or as the result of operations to that end; to remove incrustation of steam boilers.

Scale Beam.—The lever or beam of a balance; a weighing apparatus, with a sliding weight resembling a steelyard; a lever arm of a balance, supported as a fulcrum from its middle with the load to be weighed depending from one extremity, and the counterpoise or weights from the other.

Scale Drawing.—The reproduction or delineation of an object on a reduced scale, each unit of which bears a definite proportion to a unit of linear measurement by which the object itself is measured.

Scale Triangle.—In geometry, one in which no two sides are equal.

Scale Pan.—In steam engineering, a shallow trough provided in large marine and stationary boilers, for the collection of fine sediment which is *ballooned* to the surface by the ebullition of the steam. Also called *sediment collector*.

Scale Perspective.—A modified form of perspective, in use for technical drawings, where perspective is employed to permit the delineation of more than one side of an object, but the dimensions of that object are drawn to *scale*, thus not being reduced or diminished, as their lines recede from the point of view, as in true perspective; this permits of scale measurement. Also known as *approximate perspective*.

Scale Rule.—1. A graduated measurement wherein a large linear dimension is represented by a smaller. By this means, a structure or machine may be represented in a small drawing, each quarter inch of the drawing being equal to one foot of the structure, and so on. Such scales range from those of a map, where some hundreds of miles may go to one inch, up to those of engineering details, which are usually one fourth to one half the size of the original.

2. A rule graduated in accordance with the foregoing, whereby a draughtsman reads off feet, yards, miles, etc., without conversion.

Scales.—1. An instrument or machine for weighing; chiefly used in the plural when denoting the whole appliance.

2. The dish of a balance such as used in stores for weighing small amounts of merchandise.

Scaling Tools.—1. In steam engineering, tools used in loosening and removing the scale formed in boilers.

2. In metal working, tools used in the preliminary processes in the manufacture of tin plate.

Scalping.—1. In flouring, to separate the fuzzy growth from the ends of wheat or other grain berries by attrition, with or without the use of suction or blower fans.

2. To partially separate the product from the first break rolls, by means of a sifting arrangement, into broken wheat and break flour, etc.

3. To separate the finished products after each set of rolls, sometimes six successive times in certain arrangements of mill machinery, by means of sieves, bolts, or screens of varying degrees of fineness.

Scan.—To go over and examine, point by point; to look closely at or into.

Scantling.—1. The dimensions of certain building materials, such as stones, timber, etc., with regard to their length, breadth and thickness.

2. A name given to timbers of less than 5 inches square, as used for studding, ties, etc.

3. The general dimensions of the parts of a structure or ship. Thus, one vessel is said to have heavy *scantling*, showing that her shell plating is heavy compared with the required standard, and that the framing is substantial. Much used as a relative term.

Scapple.—To work roughly, or shape without finishing, as a stone before leaving the quarry. To dress in anyway short of fine tooling or rubbing, as stone.

Scarcement.—1. In mining, a small projecting ledge left to act as a support for a ladder in a shaft, etc.

2. In building, a recess left as a foot hold, or to secure the end of a plank.

Scarf.—1. In carpentry, a joint uniting two pieces of timber *endwise*. The ends of each are beveled off, and projections are sometimes made in the one corresponding to a cavity in the other; the two are held together by bolts and sometimes also by straps.

2. In blacksmithing, the flattened or chamfered edges of iron prepared for welding. The two surfaces being drawn out obliquely, a larger contact is given to them, which fortifies the junction.

Scarf Joint.—In carpentry, a joint made by overlapping and bolting or locking together the ends of two pieces of timber that are halved, notched or cut away, so that they will fit each other and form a lengthened beam of the same size at the junction as elsewhere.

Scarf Weld.—A joint that is made by overlapping and welding together the scarfed ends or edges of metal rods, sheets, etc.

Scarifier.—In agriculture, an implement for breaking up the surface of the soil, having eight to ten tines provided with removable points varying from a sharp wedge to a nine inch hoe; the whole mounted on a four wheeled carriage.

Scarp.—To cut down perpendicularly or nearly so; as, to *scarp* the face of a ditch or a rock.

Scavenger Roller.—In cotton spinning, a roller used to clean off fluff and waste from those parts of the machine with which it is in contact.

Scavenging.—In internal combustion engines, the expulsion of burnt gases from the cylinder after explosion, the operation being sometimes assisted by a jet of fresh air. A scavenging effect is produced in four cycle engines, by means of a long exhaust pipe with easy bends, the momentum of the gases producing a partial vacuum in the cylinder. If the exhaust and admission valves be placed diametrically opposite each other, on the sides of the clearance space, the same effect may be produced, the process being aided by holding open the mechanically operated exhaust valve until the piston has begun its charging stroke.

Scavenging Cylinder.—A cylinder in which air is compressed to sluice out the cylinder after explosion; or, more properly, one which exhausts the products of combustion, the charging piston delivering a new charge under pressure before the completion of the stroke, thus attaining a four cycle operation with two strokes of the engine.

Scavenging Stroke.—The exhaust stroke of an internal combustion engine is frequently known by this name, especially if means be taken to produce a scavenging action.

Schedule.—A formal list or inventory prepared for business purposes; as, a list of tools or supplies.

Schist.—Any rock that readily splits or cleaves; slates and schists are essentially the same.

Schistose.—Of, resembling, or having the nature of schist.

Scholium.—In mathematics, a remark or observation made upon something going before it, after the manner of a school.

School.—An institution for learning; an educational establishment; a place for acquiring knowledge and mental training.

Schooner.—1. A fore and aft rigged yacht with two masts; trading vessels of this type are built with from three to six masts, because the fore and aft sails two points nearer the wind than a square rigger, and requires a much smaller crew. The first vessels of the schooner type are said to have been built by Capt. Andrew Robinson, in Gloucester, Mass. about 1713.

2. A large covered emigrant wagon of the western prairies, called *prairie schooner*.

Science.—1. Knowledge gained by systematic observation, experiment, and reasoning from their results; the prosecution of the search after this systematized and true knowledge.

2. A branch of knowledge, regarding the study of any special subject, systematized and arranged; the systematic arrangement of what is known concerning this particular subject.

Scientific Instruments.—The tools or apparatus wherewith analyses are made, researches conducted or any form of experiment carried out. The appliances vary according to the need of the different professions; some, as the *microscope*, *thermometer*, *barometer*, and delicate *balances*, being common to all, while others again are highly specialized. The list covers everything from the huge telescope, requiring its own building and special machinery to drive it, down to the watch-makers' eyeglass, and from the testing machine which tries a whole ship's cable at one time to the pocket steel yard.

Scintillation.—1. The emitting of light, as it were, in sparks or flashes; glittering in flashes as diamonds, etc., by artificial light.

2. In a foundry, hard white iron scintillates or throws off sparks when in the ladle. The founder knows thereby the nature of the metal while yet in its molten condition.

Scissel.—1. The clippings of metals made in various mechanical operations.

2. The slips or plates of metal out of which circular blanks have been cut; as, for the purpose of coinage.

Scissors.—A cutting instrument resembling shears, but smaller, consisting of two cutting blades with handles; often called a *pair of scissors*.

Scobs.—The dross of metals; raspings of ivory, metals or other hard substances.

Scoop.—1. The flexible end of the water pick-up apparatus which is lowered into the trough.

2. A fireman's shovel.

Scoop Shovel.—A large coal shovel used on locomotives, etc., for firing the boiler; it has a deep rounded heel permitting it

to hold a large quantity of coal and making an easy throw of the fuel into the furnace.

Scoop Wheel.—A type of wind or water wheel in which the paddles are replaced by scoops. Instead of generating power, the scoop wheel is driven by the wind or by steam, affording an effective method of pumping large quantities of water through a low lift; as, in draining low lying lands.

Score.—1. To mark with cuts, notches, scratches or gashes; as, to *score* a log for hewing.

2. In founding, to split or burst a casting by unequal cooling.

Scoria.—In a furnace, the slag rejected after the reduction of metallic ores; dross.

Scorification.—In plumbing, the melting of a small quantity of lead along with copper, which is intended to be rolled into sheets, so called because of the *scoria* which collects on the surface.

Scotch.—To prop or block with a wedge, chock, etc., as a wheel to prevent its rolling or slipping; as, a *scotch* for a wheel or a log on inclined ground.

Scotch Boiler.—A name applied to the ordinary return tube boiler, used on ship-board. It has a cylindrical shell, and contains from two to eight furnaces, very large examples having four fires at either end. The products of combustion pass from the furnace flue into a combustion chamber, of which there is usually an independent one for each furnace; from the upper part of this chamber horizontal tubes return to the end of the boiler, carrying the heated gases to the uptake, whence they are led to the funnel. Such boilers are heavy, and contain much water, but are entirely self contained, extremely durable, and are easily cleaned and repaired.

Scotch Pig.—In a foundry, for ordinary purposes, Scotch pig is that often used, both for light and ornamental castings, and mixed with other brands for the stronger and tougher castings. No. 1. Scotch mixed with scrap or with inferior brands, produces useful mixtures. It is smelted from the clay ironstone or black band ores.

Scour.—1. To rub hard with something rough, as sand; to clean by friction; to cleanse from grease, dirt, etc.

2. In woolen manufacture, the process of cleansing the wool by means of alkaline liquor to remove grease and dirt.

Scouring Barrel.—A tumbling barrel, especially for ridding castings of sand, etc., after coming from the foundry.

Scouring Paste Recipe.—The following composition is recommended for scouring woodwork or utensils, taking the place of soap or sand: 1 lb. of soft soap, 1 lb. silver sand, 1 lb. powdered whiting, 1 tablespoonful common salt; all put into a vessel containing 1 quart of boiling water; the whole to be boiled and well stirred for 15 minutes.

Scow.—A flat bottomed boat with square ends; properly, without sails or motive power; used as a lighter.

Scram.—1. To search a mine carefully, when apparently worked out, for ore that may previously have been overlooked.

2. A mine which is undergoing such a searching operation.

Scrap.—1. A small piece, a fragment; a detached incomplete piece, waste material; as, scrap iron

2. An enclosed place where a hot fire is maintained for melting pieces of metal, the scrap or refuse from boiler shops, etc.

Scraped Joint.—A joint brought to an accurately plane surface by scraping. Irregularities of the surface are found by rubbing a film of *marking* (oil and red lead) on a surface plate, or on the already finished surface which is to fit that one being operated upon. On bringing the two surfaces into contact, patches or spots of the marking appear on the high places, and these are carefully removed by the scraper, the process being repeated as often as necessary.

Scraper.—1. A hand tool for removing a very small amount of metal from a surface; it is generally a file or piece of hard steel flattened, tapered, and ground square across at the end.

2. A two handed scoop drawn by a horse or team, by means of which dirt or surface soil is excavated, removed to a short distance and tipped by the operator, who holds the handles. This implement is used for making and leveling roads, for grading and ditching railway work, etc.

3. In mining, a tool for lifting the bore meal or sludge out of a drilled hole.

Scrap Heap.—In iron works, a receptacle for odds and ends of waste material, capable of being utilized in various ways. Scrap cast iron consists, to a slight extent, of foundry wasters, but chiefly of old iron bought for the purpose of remelting, while the scrap heaps of wrought iron or steel consist of the accumulation of shop refuse and odds and ends cut to waste. Also called *scrap pile*.

Scraping.—In machinist's work, the bringing of surfaces to a very approximate plane condition by means of scrapers.

All good wearing and sliding surfaces are scraped to a fit, to obliterate the marks or grooves left by cutting tools or files, and to increase the number of minute points of contact. There is no mechanical operation by which such accurate results are possible of attainment as by scraping. To indicate the points of contact, it is customary to rub a thin film of red lead and oil on the opposite surface to that which is being scraped, which red lead indicates by its transference to certain highest points, the localized points of contact, to which points, therefore, the work of the scraper is directed.

Scraping Tools.—In machinists' work, tools which remove the particles from the materials on which they operate by abrasion, mainly or altogether, as scrapers, broaches, reamers, saws, etc.

Scrap Iron.—Broken up pieces of worn out, condemned or damaged machinery, together with shop refuse, which may be utilized in various ways. Foundry scrap consists, in great part, of spoiled castings with a certain amount of old iron, derived from broken up pieces. Steel and wrought iron scrap consists of shearings, punchings, ends of bars, and odds and ends cut to waste in the shop processes.

Scrap Steel.—In smelting, scrap steel is utilized in the open hearth processes, being mixed with pig iron and ore.

Scratch.—A break in a surface of a thing made by scratching, or by rubbing with anything pointed or rough.

Scratch Brush.—A stiff wire brush used for cleaning metallic surfaces, especially in electroplating operations; also used in cleaning castings, as they come from a foundry.

Scratch Coat.—In building the first coat in plastering. Called also *scratch work*.

Scratch Gauge.—A tool more frequently employed by joiners and carpenters than by machinists, the former having it made of hard wood, the latter of steel. A scratching point is fixed at right angles to a graduated bar or stem, along which slides a sleeve or step which may be locked in any desired position. The sleeve is set and the tool drawn along the edge of the object to be marked off, the point making a scratch at the set distance parallel with the edge.

Screed.—In building, a wooden strip or a strip of mortar laid on a wall at intervals to gauge the thickness of the plastering to be put on, so that the finished work may present a uniform appearance.

Screen.—1. A large sieve of wide mesh, on which such materials as sand, gravel, or house coal are sifted.

2. A movable partition placed before a fire to intercept the direct light and heat.

Screenings.—Very fine coal with much dust; that which has passed through the meshes of the screens or sieves used to separate the larger coal, which commands a higher price, from the dusty part of the product of the yard or mine.

Screw.—In mechanics, an inclined plane wrapped around a cylinder. The distance apart of two consecutive coils, measured from center to center or from upper side to upper side (literally the height of the inclined plane) for one revolution, is "the pitch" of the screw.

Screw Auger.—A wood boring instrument of large size, differing from the shell auger in that it has a twisted stem, while the latter is a semi-cylinder. The screw auger bores more accurately, although not so strong or rapid a tool as the other pattern.

Screw Barrel.—In a foundry, a chain barrel having a continuous spiral groove cut around its periphery to receive the links edgewise, the flat of the alternate links resting on the periphery of the barrel. Designed to maintain an even lap of the chain, and thus prevent *overriding*.

Screw Blade.—In marine engineering, a sector of a screw thread, forming one of the arms or blades of a *propellor screw*.

Screw Blank.—A piece of metal, forged or cut from a bar, preparatory to making it into a screw.

Screw Bolt.—In machinery and construction work, more commonly called *machine bolt*; signifying, therefore, a fastening made by means of a nut engaging with a screw thread, as distinguished from the riveted form of fastening.

Screw Burner.—1. A lamp burner having a screw to adjust the wick.

2. A burner which screws into the top of the lamp.

Screw Chasers.—Combs used to finish or dress inside or outside threads, or to form a thread by hand. Also known as *thread chasers*.

Screw Chuck.—A chuck used by wood turners, which saves the necessity either of attaching a driver to the work, or of chucking it on a plate. A small tapering screw point projects from a chuck, serving as the lathe center; the piece of wood to be turned is screwed upon this and is held fast in its proper position without bolts or clamps.

Screw Clamp.—In carpentry, the ordinary clamp used by wood workers. Small screw clamps are sometimes called *thumb screws* to distinguish them from the larger timber or bar clamps.

Screw Conveyor.—A worm or helix composed of plates attached to a central shaft which rotates within a trough, casing or conduit. The worm, as it rotates, causes material to traverse the trough, thus saving labor and preventing dust.

Screw Cutting.—The operation of cutting threads by means of a tool with a single point, whether the thread be internal or external. The formation of screws by means of tools with several teeth is known as *chasing*.

Screw Cutting Lathe.—A lathe fitted with a leading screw and change wheels, so that varying rates of feed may be given to the slide rest relative to the rotation of the lathe mandrel, thus rendering it possible to cut screws or threads of different pitches.

Screw Dock.—A dry dock for small craft, the vessels being floated on a platform or gridiron, which is then lifted out of water by the aid of jack screws, operated through capstans.

Screw Down Valve.—In pipe fitting, a valve which is raised or depressed by means of a screw. *Globe valves, sluice valves,* and other similar types are familiar examples.

Screw Driver.—An implement with a point resembling that of a chisel, but blunt: used for the rotation of screws when inserting or withdrawing them, the tool fitting in *a nick in the screw head*.

Screw Couplings.—A type of coupling in which links are strained together by means of a right and left handed screw.

Screwed Ferrules.—Short brass tubes or cylindrical rings having a male thread their whole length, and a nick on one end for a screw driver. They are placed over condenser and similar tubes, and screwed into a stuffing box or recess in the tube plate, compressing the packing around the tube and gripping it fast. Some ferrules have two internal diameters, one the size of the tube, the other the size of its bore, the step or collar thus formed, serving to prevent the tube from moving endwise.

Screwed Stay Bolts.—Stays supporting the fire boxes, combustion chambers, etc., from a boiler shell; they are threaded from end to end and screwed through both plates. In marine and similar boilers, these stays have a nut and washer on each end, but as, that plan would not answer in fire boxes, owing to the nut burning off, a riveted head is used instead. Locomotive fire box stays are sometimes drilled with a central hole into which a taper drift is driven to expand the stay.

Screwed Stays.—Those stays within a boiler which are screwed through the two plates which they support, and are reinforced by riveting or nuts on either or both ends. They are usually of less diameter than $1\frac{1}{4}$ inch, the thread being usually continuous from one end to the other. Screwed stays are employed to support the combustion chambers of return tube boilers from each other and from the shell plating, as well as to stay the fire boxes of boilers of the locomotive type. Also known as *screw stays, stay bolts*, etc.

Screw Engine.—In marine engineering, an engine specially designed to drive the screw of a steamer.

Screw Eye.—In hardware, a wood screw of which the head is shaped in the form of a ring.

Screw Gearing.—Otherwise known as spiral gearing: the transmission of power by means of a worm and worm wheel.

Screw Glands.—Used to hold the packing around the tubes in condensers; they are made from a tube, threaded, parted off, and nicked with a saw on the end.

Screwing Machine.—A machine for forming threads, by means of solid, adjustable or expanding dies, upon bolts, bars, etc.

Screw Jack.—A device whereby a powerful force may be exerted through the continued application of a small force acting through a comparatively long period of time. The jack consists essentially of a vertical screw, working in a nut, within a substantial frame; rotation of the screw, by means of levers or toggles thrust through holes in its head, causes a multiplication of the power exerted, equal to the circumference of the path traveled by the force on the bar, divided by the pitch of the helix.

Screw Machine.—An apparatus for the manufacture of wood screws; rolling the thread upon the blanks instead of cutting them, as is the case with machine screws.

Screw Nail.—In hardware, a common wood screw, as distinguished from an ordinary nail driven in by percussion, the term being akin to the term *screw bolt*.

Screwpile.—In construction, a pile of timber, wrought or cast iron, usually cylindrical or tubular in section, to permit it to be more easily turned, and furnished with a cast iron screw disc, having a flattened helical thread, similar to an ordinary wood screw, together with an auger like point. The screw pile is rotated, usually by hand power, by means of a capstan, and, as it enters the ground, fresh lengths are added, and spliced or bolted on to make up the correct height. In hard ground, a water jet through the middle of the pile facilitates sinking.

Screw Pitch Gauge.—A small instrument furnished with a number of thread gauges, usually ranging from 28 to 6 per inch, for ascertaining the pitch or number of threads per inch of any given screw. The various gauges are mounted, like blades on a pocket knife.

Screw Plate.—A tool furnished with a graduated series of screwed holes whereby threads of small diameter, usually under $\frac{1}{2}$ inch, may be formed. Screw plates are made of different sizes and thicknesses according to the size and range of holes, with which they are provided, the smallest size made being capable of cutting threads on a fine needle. Corresponding taps are generally furnished with the plates.

Screw Press.—A press for stamping or drawing work in which the power is applied by means of a screw; frequently having two or four fly weights attached to arms projecting radially from the screw, in order to increase the effect; also called *screw jack*.

Screw Propeller.—The arrangement of two, three or four helical segments, each constituting part of a different screw, which applies the power of a vessel's engines to the water. Each segment constitutes a vane or blade, and is either cast solid with the boss, or else attached to it by bolts and studs. The travel of a ship through the water for each revolution, is equal to the pitch less a certain percentage of slip.

Screw Shaft.—The tail shaft of a marine engine, piercing the vessel's hull by means of the stern tube, and bearing the propeller on its outer end. Also known as *stern-shaft*, *propeller shaft*, etc.

Screw Threads.—There are many kinds of screw threads in general use among mechanics; the three more important are: (1) the V standard thread, having an angle of 60° between its sides which is one of the standards for machine bolts; (2) the *Sellers* or *U. S. Standard* thread, with an angle of 60° , one eighth being flattened off at top and bottom of the thread; (3) the *Whitworth*, having an angle of 55° , one sixth of the depth of the thread being rounded off at top and bottom.

Screw Vise.—A clamping device, consisting usually of two jaws made to be closed

together with a screw, and commonly attachable to a bench; used for grasping or holding a piece of work that is being operated upon.

Screw Wrench.—A wrench for turning a screw; a wrench with an adjustable jaw that is moved by a screw.

Scribe.—An awl or spike used by brick-setters to mark bricks on back and front, so that they may be accurately cut to a proper taper for gauged work.

Scribe Awl.—An awl used for marking lines to be followed in sawing or cutting out work.

Scriber.—A steel tool for marking lines on work. The scriber used by machinists is usually pointed at both ends, one end being turned at a right angle to mark or test surfaces; other patterns have a point at one end and a hook at the other. The scriber used for marking timber has a point at one end, for scratching, and a knife at the other for cutting, the marks. Also called *scriever*.

Scribing.—In carpentry, the adjustment of adjoining pieces of wood so that the grain of one shall be at right angles to that of the other.

Scribing Block.—An instrument used to measure off center lines on work when laid on a surface plate; a *surface gauge*.

Scribing Iron.—A scoring tool for marking logs and casks. A *race knife*.

Scribe Board.—In ship building, a surface of clamped boards, large enough for a full sized midship section of the vessel under construction, on which are scribed, or drawn with a knife, the outlines of each frame for the information of the workmen.

Scripping Bar.—In calico printing, a bar of iron or brass with a curved surface grooved right and left from the center, used to spread out and smooth the fabric as it enters the printing machine.

Scroll.—In carpentry, an ornament of a form derived from, and resembling, a partially unrolled scroll of parchment.

Scroll Chuck.—A self centering chuck, either with three or four jaws, in which the jaws are advanced or retired by the revolution of a spiral scroll, within the chuck, which engages with corresponding teeth on the back of the jaws.

Scroll Iron.—In architectural iron work, iron made into an ornament: formed of undulations giving off spirals or sprays, usually suggestive of plant form or Roman patterns.

Scroll Saw.—A ribbon of steel with saw teeth upon one edge, fastened and winding upon the wheel at the top, moved vertically by the pitman, and kept in tension by the springs. An air pump is sometimes provided to blow the sawdust away from the work on the table. What is more generally known as a *band saw*, is occasionally given this name.

Scrub.—In mechanics, to rub anything hard, especially with a wet brush; to *scour*.

Scrubber.—In gas making, an apparatus for freeing the gas from tarry impurities and ammonia. It consists essentially of a tower, in which are numerous trays filled with broken coke. The ascending gas, passing through the interstices of the coke, is met by descending sprays of water, which wash down the ammonia and any tarry or carbonaceous particles that have not been previously deposited in the condenser. The ammoniacal liquor is drawn off by means of a siphon or pump from the base, while the washed gas goes to the purifiers.

Scud.—1. To sail rapidly before a strong wind.

2. In tanning, to remove hair roots, fat, lime salts, etc., from the wet skins while they are in a limed state. This is done by means of a blunt knife or slate, over a beam.

Scudding Knife.—In leather manufacture, a hand knife used in removing fat, hair, dirt, etc., from hides after unhairing.

Scull.—To propel, as a boat, with a pair of short oars, called sculls, or with a single scull or oar, worked over the stern obliquely from side to side.

Scum.—The extraneous matter or impurities which rise to the surface of liquids in boiling or fermentation; also, the scoria of metals in a molten state; *dross*.

Scum Cock.—In a steam boiler, a surface blow-off designed and arranged to remove floating impurities or scum.

Scuppers.—In a ship, drains fitted to the waterways at the sides of the deck.

Scutch.—In textile manufactures, to beat or whip slightly; to dress by beating and separating woody fiber from valuable fiber of retted flax stocks; to beat and

loosen the fiber of; as, the filaments of cotton; to free from dust by blowing.

Scutcher.—An implement for separating hemp or flax from the stalk; a scutch.

Scutching Machine.—In cotton manufacture, a machine used to scutch cotton. Also called *battin machine*.

Scuttle.—1. A wide mouthed vessel for holding coal; a *coal hod*.

2. The lid or door which covers or closes an opening in a roof, wall or the like.

3. In a ship, a small opening or hatchway in the deck, large enough to admit a man, and with a lid to cover it; also a like hole in the side or bottom of a ship.

Scythe.—1. In mowing machinery, an implement with a long curved blade attached to a conveniently bent handle on the sides of which are fixed two pegs for the mower to grasp.

2. In reaping machinery, the vibrating cutting knife.

Sea Cock.—In marine engineering, an injection cock which is placed upon the sides of a steamer, leading from the sea to the condenser. It is supplementary to the usual injection cock.

Sea Injection.—In marine engineering, the valve which controls the admission of cooling water to the condenser.

Seal.—A term applied to water retained in a pipe, bend, or other vessel, to prevent the passage of gas or air; as in a gas holder or a sewer trap.

Sealing Wax.—A mixture, as of shellac and turpentine, with an added coloring matter, that is fluid when heated, but quickly solidifies on cooling; used for making seals, as on letters or bottles.

Seal Oil.—A commercial oil obtained from the fat or blubber of the seal, principally the hooded or hairy seals off Newfoundland and Labrador. It is used in currying leather, in preparing chamois leather, as a lubricant, and for tempering certain steel articles.

Seam.—In mining, a stratum or bed of mineral; a continuous layer, especially with reference to coal.

Seaman.—One whose occupation is to assist in the management of ships at sea; a mariner; a sailor; applied to both officers and common mariners. Opposed to *landsman* or *landman*.

Sea Mark.—Any elevated object on land which serves as a guide to mariners; a beacon; as, a hill, a tree, a steeple, or the like.

Seaming Iron.—In metal working, a tool for joining or working the edges of sheets of metal.

Seaming Machine.—An arrangement of appropriate rollers, used by sheet metal workers, to form seams, or joints, by bending the edges over, or doubling them; a power press.

Seaming Press.—In metal working, a machine for uniting the edges of sheet metal plates by bending them and pinching them together.

Seam Set.—A grooved set used by sheet metal workers to close up a seam by hand in connection with a stake.

Search Light.—A powerful arc light, whose lenses are arranged to throw the beams of light in parallel or divergent rays in any direction, thus serving purposes for navigation in narrow waters, for naval and military operations, and for signaling against the sky.

Searing.—In a foundry, the practice of smoothing the surface of the rougher class of foundry patterns with a flat faced red hot iron as a substitute for paint or varnish. The grain is thereby smoothed and prevented from rising up when in contact with the damp sand.

Season.—In mechanics, to fit or prepare by drying or hardening, or removal of natural juices; as, to *season* timber.

Seasoning.—In civil engineering, the process of exposing timber to the open air and drying the moisture out of its fibers, or drying the timber by putting it in steam kilns when under pressure.

Seat.—1. To sit or cause to sit upon anything.

2. The bedding of anything upon its foundations or bases, or the adjustment of one part with that other upon which it rests, so that it cannot rock or vibrate.

3. The portion or face of a building stone which rests upon the mortar bed.

4. The piece whereon a valve rests when closed, and from which it rises on opening; as, in a safety valve or stop valve.

Seating Block.—A special wedge shaped brick or block of fire clay, having a broad base; used to support the shells of

Lancashire and other boilers which require to be set in brickwork.

Seat Pillar.—The tube, projecting from the frame of a bicycle, which supports the rider's seat.

Seat Tube.—The vertical or inclined member of the frame of a bicycle which directly supports the weight of the rider. The seat pillar slides within the seat tube.

Sea Wall.—An embankment or dike built of, or faced with, masonry to serve as protection against the sea, preventing erosion of cliffs or inundations.

Sea Water.—The water of the ocean, usually impregnated to a large degree with salt.

Sea Water Precipitator.—An apparatus for freeing sea water from its magnesium and calcium salts, thus leaving sodium chloride alone in solution. The salt water is treated with a powder consisting chiefly of soda ash, and is heated by steam in a closed vessel until a pressure of ten pounds per square inch is attained. The dangerous salts then separate from the water, and the latter is filtered out under pressure into the hot well. Thus, a ton of sea water can be dealt with in one and a quarter hours in a small precipitator, easily giving twelve tons a day of prepared water for feed "make up" purposes.

Secant of an Arc.—In geometry, a line drawn from the center of the circle to the extremity of the tangent.

Second.—1. One sixtieth part of a minute of time, or one 3600th part of one hour.

2. In the duodecimal system of mensuration, the twelfth part of an inch or prime; a line.

Secondary.—Succeeding next in order to the principal part.

Second Cut.—A grade of file tooth of medium roughness. The cut usually employed for ordinary filing purposes.

Second Motion Shaft.—A secondary shaft, usually driven by multiplying gear from the engine, from which the power is taken off. An example of the use of this shaft is seen in rolling mills driven by a beam engine; the spur fly wheel of the engine gears into a pinion on the second motion shaft, the latter being geared to the rolls, usually through clutches.

Second Speed.—On automobiles, one of the change speed gears in the transmission gearing.

Second Tap.—A hand tap for intermediate use, of cylindrical form, with a slight taper on the bottom threads; of use for following the taper tap, especially where the thread does not "bottom." Sometimes termed the *plug tap*.

Secretary.—A writer; one who attends to correspondence and transacts other business for an association or for another person.

Sectile.—Capable of being cut; capable of being severed by the knife with a smooth cut; said of minerals.

Section.—1. A part separated from something; a portion.

2. In mechanical drawing, the description or representation of anything as it would appear if cut through by any intersecting plane; as, a *longitudinal section*; a *cross section*; an *oblique section*, etc.

3. In a reaping machine, one of the triangular steel knives, like a shark's tooth, which go to form the knife or scythe.

Sectional.—In drawing, showing the section of an object at its intersection by a given plane.

Sectional Boiler.—1. A water tube boiler, in which the tubes are expanded in a series of headers, each forming a section or unit, all of which connect with one drum.

2. A number of uniform cast iron sections, each with a passage for the furnace space, and socket connections for steam and water spaces; these being bolted together on a suitable base, form a portable boiler.

Sectional Covering.—Non-conducting material, such as magnesia or asbestos, made into cylindrical or other segments to fit around steam pipes, etc., thus enabling the covering to be quickly removed for repairs or alterations, and as quickly replaced.

Section Boss.—The foreman over the gang of trackmen keeping a section of railway in repair.

Section Colors.—The colors used in drawings to indicate sections of various materials. Cast iron section is gray, wrought iron section is blue, steel section is purple, gun metal and brass sections are generally gamboge, wood is brown; when colors are not used, conventional varieties of shading are employed.

Section Lines.—Symbolic hatching of sections on a drawing, indicating the nature of the material, such lines being usually drawn with the 45° set square.

Uniform lines indicate *cast iron*, lines in pairs represent *cast steel*, one thick line between each light pair denotes *wrought steel*, etc.

Sector.—1. In geometry, a part of a circle comprehended between two radii and the included arc.

2. A mathematical instrument for laying down plans, measuring angles, etc. It has two legs united by a rule joint and graduated.

3. A variety of two fold rule, used by draughtsmen as a kind of bevel to erect angles; it is also used to set out polygons, and will give the diminishing proportions of chords, sines, tangents, secants, etc.

4. An astronomical instrument, consisting essentially of a graduated circle, used for accurately measuring the zenith distance of stars which pass near the meridian; also for finding the latitudes in trigonometrical surveys from stellar observations.

Secure.—To make safe; to guard; to assure; to make fast; to make one's self secure.

Sediment.—That which subsides at the bottom of a liquid; silt; mud; slime.

Sedimentary.—In geology, formed of materials deposited as sediment by water. Sandstone and shale are sedimentary rocks formed, respectively, from sand and mud deposited by bygone rivers and seas. All stratified rocks are sedimentary.

Seed.—In *glass making*, small bubbles formed in imperfectly fused metal, which assume oval shapes, like the seeds of plants, as the plastic glass is manipulated.

Seed Bag.—In an artesian well, a packing to prevent percolation of water down the bore hole. It consists of a bag encircling the tubing and filled with flaxseed, which swells when wet and fills the space between the tubing and the sides of the hole.

Seed Crushing Rolls.—A roller mill, with chilled cast iron rolls, by means of which oil bearing seeds are crushed into meal for the purpose of expressing oils.

Seed Drill.—An implement for planting seed. A two wheeled carriage is provided with hoppers for seed and manure, proper mechanism regulating the rate of distribution. The seed and manure fall through a series of funnels into a furrow made by a coulter; a following hoe buries the seed.

Seep.—To soak through pores; to lose liquid by drainage.

Seethe.—To steep or soak; to be in a state of ebullition or boiling.

Seger Cone.—A pyrometric device used to measure the heat of a furnace or pottery kiln. The cones constitute a series of slender triangular fire clay pyramids, about 3" high by 1" broad at the base, each being slightly less fusible than the next. The temperature at which each becomes plastic is known, its "weeping" or bending over, until its apex touches the hearth on which it stands, indicating the degree of heat, which is read from the Seger scale.

Segment.—1. One of the parts into which a body naturally separates or is divided; a part cut off from a figure by a line or plane; especially, that part of a circle contained between a chord and an arc of that circle, or so much of a circle as is cut off by the chord.

2. A part of a ring, as a segment of a sectional fly wheel.

Segmental Saw.—A circular saw, such as is used for cutting up veneers, etc., the cutting portion consisting of separate segments screwed to the edge of a metallic chuck or disc.

Segment of a Circle.—In geometry, the part of its area enclosed within an arc and its chord.

Segment of a Sphere.—The part of a sphere cut off by a plane or included between two parallel planes.

Segregation.—1. The act of separating from others, the process of forming into a distinct portion or mass.

2. In crystallization, the process of separating from a mass and crystallizing around different centers.

3. In geology, and mineralogy, the issuing out of veins or seams, or from nodula masses of metallic matter, of some substance differing in form or in character from the material which encloses it.

Seismic.—Appertaining to or produced by earthquakes; of the nature of an earthquake.

Seizing.—1. The lashing or securing of two ropes or two parts of a single rope by binding them around with smaller line or yarn.

2. The yarn or cord used in seizing a rope or ropes.

3. Binding or gripping of a moving part in its bearings, when the parts have become incorporated by overheating or lack of lubrication. Steel on steel is very apt to seize, and therefore, it is good practice to face bearings for steel shafts with some other metal, as brass.

Selenium.—A rare non-metallic element, closely resembling sulphur in its behavior, and found in conjunction with

that substance and with tellurium. Its name is derived from *seleno*, the moon, as that of tellurium is from *tellus*, the earth. The electrical resistance of selenium changes remarkably under the action of light, consequently selenium cells are much employed in certain classes of apparatus, notably the *photophone*, where sound is transmitted along a beam of light which is directed upon a selenium cell, the variation in the light altering the current and reproducing the sound.

Self Acting.—In machinery, a machine or some section of a machine whose movements are not executed by a direct intervention on the part of the attendant, but which are derived immediately from the motions of the machine itself. The chief motions in ordinary machines are rendered self acting through the intervention of *screws, cams, gearing, levers*, etc.

Self Acting Lathe.—One in which the tools are fed to the work by means of gearing actuated by the lathe itself, instead of being traversed by hand.

Self Adjusting Coupling.—1. A compression coupling for connecting lengths of shafting together, having coned sleeves, whose grip is adjusted by turning threaded collars upon them.

2. A reversal of the parts of an expanding mandrel, which may be enlarged to fit any hole within a certain range.

Self Centering Chuck.—One in which the jaws, usually three in number, are opened or closed simultaneously by the turning of one screw only. The jaws are moved in or out by the rotation of a scroll, and as each moves exactly the same distance, it is easy to set work true. Small sizes are very useful for holding twist drills and metal rods; the larger sizes for gripping work to be polished, etc. Such chucks easily become strained and the scroll is apt to break, so it is not advisable to use them for heavy work.

Self Conduct.—That which gives a safe passage; a writing, a pass, a warrant of security given to a person to enable him to travel with safety.

Self Contained Machine.—In machinery, machines whose parts are not attached to distinct fixtures, but are all so combined, that one foundation or attachment is sufficient. Thus, a radial drill is self contained, when the table and pillar are bolted together, instead of, as is often the case, the radial arm being attached to a wall or pillar, while the table is bolted to the stone foundation. Independent machines may be considered as self contained.

Self Fluxing Ores.—In metals, some red iron ores contain sufficient matter so as not to require additional flux, hence the term *self fluxing*; they occur in Sweden chiefly.

Self Ignition.—In an internal combustion engine, premature explosion of the charge through contact with an overheated cylinder head or wall, or with a heated deposit of carbon or soot.

Self Made Man.—A man who has risen from poverty or obscurity by means of his own talents or energies.

Self Oiling Bearings.—Bearings which are provided with a reservoir or cellar for oil underneath the journal; a ring or chain, loosely encircling the shaft, rotates with it and carries up a continuous stream of oil from the reservoir.

Sell.—To transfer to another for an equivalent; to dispose of in return for something, especially money. Sell is opposed to *buy*, as one party *buys* what another *sells*.

Sellers Thread.—The standard screw thread of the United States, having an enclosed angle of 60° between the threads, and one eighth flattened at top and at bottom.

Selva.—The edge of cloth, woven in such a manner as to prevent raveling, and often closed by complicating the threads; list.

Selvage.—A strap of rope yarns untwisted but knotted at intervals.

Semaphore.—A signaling apparatus consisting of a vertical post with one or more hinged arms projecting from it, by whose movements, relative to the post, pre-arranged signals may be transmitted. The usual method of signaling to moving trains on a railway, and also on warships.

Semi-automatics.—In machinery, these constitute a large class of machines which occupy a middle position between the entirely or full automatic machines and those which involve the constant attendance of an operator. The term is chiefly applied to turret and screw machines. Usually several movements are automatic, but not all. Thus, the stock may or may not be fed through the hollow spindle and gripped in the chuck by power, the turret may be rotated and brought up to its work by hand or by power. The screwing dies may be self opening or self closing, by hand or by power. But the point is, that somewhere in the cycle of operations, the attendant has to interfere to keep the cycle progressing. There is little to distinguish them from the automatics. They are made in many types, and in shops that deal with a miscellaneous and general class of work they are often more adaptable than the full automatics.

Semi-chord.—In geometry, half the length of the chord of an arc.

Semi-circle.—A half circle; that portion of the circumference of a circle cut off by a diameter, enclosing an arc of 180° .

Semi-column.—A half column; a column bisected along its length, or along its axis.

Semi-detached.—Half detached; partly distinct; separate.

Semi-elliptic Spring.—A plate spring bent to the flattened curve of half an ellipse. Also known as *half elliptic spring*.

Semi-liquid.—A fluid body having great viscosity and consistency; such as hot pitch, tar, heavy syrups, etc. Soft bodies like tallow, which "run" under pressure, are known as *semi-solids*.

Semi-portable Engine.—A steam engine with horizontal cylinders mounted on a locomotive boiler, the whole dismounted from its wheels and standing upon an iron base or entablature, forming a very compact power plant. A superior but similar class of engine, with the cylinders beneath the boiler, as in a locomotive, is known as the *under type engine*, and is frequently used for small powers.

Semi-weekly.—At intervals of half a week each; that which comes or happens once every half week; as, a *semi-weekly* trip.

Send.—To give motion to; to cause to be borne or carried; to cast; to throw.

Sennit.—In rigging, a braided cordage made by plaiting three or any odd number of ropes together; a coarse hempen yarn.

Senses.—The five senses are the special senses of sight, smell, hearing, taste, and touch; the faculty of *sensation*.

Sensible Heat.—That part of heat which produces a rise in temperature, as shown by the thermometer, in distinction from *latent heat*.

Sensitive Drill.—A small pillar drilling machine with a counterweighted spindle, whose feed is applied by the operator through a lever, thus rendering possible the use of the finest drills without risk of breaking.

Sensitized Paper.—Paper so prepared as to be sensitive to the action of light. For photographic printing, the paper is prepared with chloride of silver; for blue prints, a mixture of potassium ferricyanide and a ferric salt is employed.

Sentinel Valve.—A safety valve on a boiler or other vessel under pressure, connected with an automatic alarm device in connection with overpressure. Small valves of this pattern were formerly fitted to boilers, being set at a few pounds above the blowing off point of the main safety valves, their object being to give an alarm if the safety valves failed to act.

Separate Expansion Valve.—A term denoting the employment of a gridiron valve, controlling the admission of steam only, and working upon a separate face, which divides the valve chest into two portions. This type is rarely used in modern engines, the cut off valve riding on the back of the main valve, which serves as its seat or face.

Separating Ore by Hand.—Various terms are used for this process, as *ragging*, which means the preliminary breaking and rejection of thoroughly worthless matter; *spalling* means practically the same, but is generally applied to a second and more thorough operation. *Cobbing* is applied sometimes to a still more thorough sorting process, but generally signifies breaking the ore into convenient lumps for the smelter, while *buckling* is pulverizing ores, etc., for jigs and other concentrating machines. All the above operations are performed by hand.

Separator.—1. A device attached to steam pipes, consisting of a U shaped chamber, furnished with baffles, deflectors and diaphragms, to riddle entrained water from live steam, before it enters the engine, or to separate oily particles from exhaust steam on its way to the condenser. A reservoir is generally provided at the bottom of the chamber, furnished with a gauge glass and drain cocks, the collected liquid being usually automatically removed by a trap.

2. A term much applied to the *threshing machine*, which separates grain from the ear in which it grows.

3. A whirling machine, for separating cream from new milk by centrifugal force.

Sepia.—In drawing, a brown pigment prepared by treating the ink of the cuttlefish with caustic alkalies; used in water colors, etc.

Series.—1. A succession of things or events.

2. In mathematics, an indefinite number of terms succeeding one another.

3. In geology, a number of strata possessing common minerals or fossils.

Serif.—A hair line, light line or stroke, crossing or projecting from the end of a main line or stroke in a letter, as the top and bottom in the letter M.

Serpentine.—1. In minerals, a substance or rock consisting chiefly of the hydrous silicate of magnesia. It is usually of an obscure green color, often with a spotted or mottled appearance resembling a serpent's skin.

2. In mechanics, winding or turning one way or the other, like a moving serpent; zigzag.

Serrated.—Toothed or notched along the edge, like a saw. The word is derived from the Latin: *serra*, a saw.

Served.—In rigging, lapped or curved with marline or fine cord, laid spirally.

Service.—The act of serving; the performance of labor for remuneration and for the benefit of another, or at another's command.

Serviceable.—Prepared for rendering service; fit for the performance of duty; hence, active; diligent.

Service Box.—In paper making, a receptacle into which is discharged the water from the saveall and vacuum boxes, to be used instead of fresh water for diluting the pulp in the mixer.

Service Pipe.—A pipe connecting mains with a dwelling; as, in gas pipes and the like.

Service Reservoir.—A water supply reservoir, to contain the filtered water necessary to supply its immediate neighboring district.

Serving.—In rigging, the covering of a rope with spun yarn, to protect it from chafing against the pulley or drum, over which it works.

Serving Board.—In rigging, the board employed in serving or winding the spun yarn around a rope. Its shape is somewhat like that of the letter T. The yarn is wound around the rope in a transverse direction and is tightened as it is wound by being reeved round the neck of the board, while the handle affords the necessary leverage for pulling the yarn taut.

Sesses.—In soap making, an assemblage of rectangular frames, connected together by screw rods. They serve as a sort of mould or well in which soap is poured to solidify.

Session.—The time, period or term during which a council, or association, meets daily for business.

Set.—1 To prepare for use; to make ready; as, to bend the teeth of a saw to one side or other from the median line, or to spread thin ends by swaging.

2. Permanent change of figure in consequence of excessive strain; as, from compression, tension, bending, twisting, etc.; as the set of a spring.

3. A kind of punch, used for bending, indenting, or giving shape to metal; as, a saw set.

4. In pile driving, a piece placed temporarily upon the head of a pile, when the latter cannot be reached by the hammer or weight, except by the means of such an intervening piece. Also spelled *sett*.

5. In mining, a timber frame used to support the lining of a shaft, or to support the walls and roof of a subterranean passage, also called a *dunze*.

6. The same as a lift of well pumps, including plunger clackpiece, windbore and cistern.

Set Collar.—A collar or ring held on a shaft by set screws, which serves to prevent end play on line shafting or to make longitudinal adjustments of shafts or spindles.

Set Hammer.—1. A smith's hand tool resembling a flatter, but much more substantial, used for *setting* or straightening flat bars or plates.

2. A hammer into which the handle is simply *set* or driven, instead of being wedged.

Set Off.—A term used in a general way to signify the production of an abrupt shoulder in a piece of work, or the standing out of one portion of a structure at an abrupt angle from another portion. Also called *offset*.

Set Screw.—A screw with a pointed or cupped end, used to secure a pulley upon a shaft, or for like purposes.

Set Square.—In mechanical drawing, a triangular piece of vulcanite, wood, etc., employed by draughtsmen, in conjunction with the tee square, in order to draw lines at various angles with those drawn by the aid of the latter. One angle of the set square is a right angle.

Setting.—1. The sharpening of a razor or other edge tool upon an oilstone or hone.

2. In sawing, the outward bending of the saw teeth, in alternate directions, thus increasing the width of the kerf or saw cut, and enabling the tool to work without rubbing upon its sides.

3. In masonry, etc., the placing of stones in their proper position in a wall.

4. The hardening of mortar, cement, or the like.

5. The adjustment of anything; as, the *setting* of the hands of a watch or of a valve in a steam engine.

Setting Brakes.—In a railway, the act of applying the brakes to the wheels of a train, either by hand or through the medium of a continuous air brake system.

Setting Up Screw.—In steam engines, a screw for making adjustments, or to take up the wear of brasses in journal boxes.

Settle.—1. To free from muddiness; cause to become clear or transparent; also, to precipitate; as, dregs.

2. To render firm and passable; said of roads and pathways that have become miry.

Settling Reservoir.—A receiving reservoir in which river water, etc., is retained for a time, that it may deposit the mud or soil in solution, before being passed through the filter beds.

Seven.—The sum of one and six; a number.

Sevenfold.—Seven times as many or as great.

Sew.—To unite or fasten together with a needle and thread.

Sewage.—The contents of a sewer; refuse liquids or matter carried off by sewers; sewerage.

Sewage Distributor.—A device consisting of perforated pipes, or some form of rotary spraying apparatus, for distributing liquid sewage either over bacteria beds or over the soil to be fertilized by irrigation, in a sewage farm.

Sewage Ejector.—A device along the lines of the *sewage lift*, for discharging sewage, under air pressure, from the cellar of a building or other low lying place, to a high level sewer.

Sewage Lift.—In hydraulics, an automatic arrangement for pumping sewage from a low lying district to a higher level for disposal. A pair of chambers are arranged for alternate working, one discharging while the other is filling. As soon as one chamber is full, the floats shut the admission valves and open the discharge, at the same time opening the compressed air jet; this is supplied from a central station, through an underground main, to the entire system. As soon as the air has blown the sewage down to a proper level the floats close the air and discharge valves, opening the sewage admission valve once more.

Sewer.—A conduit or drain to carry off excess rain water, soil and other refuse matter, of a town or city.

Sewer Gas.—Any gas arising from sewage in drainage systems. To test for sewer gas: saturate unglazed paper with a solution of one troy ounce of pure acetate of lead in eight fluid ounces of rain water; let it partially dry, then expose in the room suspected of containing sewer gas. The presence of gas in any considerable quantity soon blackens the test paper.

Sewer Trap.—A sealing apparatus whereby gases from the main sewers are prevented from passing into the branch system of a house, or building, although giving a free passage to the sewage from the branch.

Sewing Horse.—In saddlery, a species of clamp or vise used to hold leather while it is being sewn. The horse is fixed against the work bench and its jaws are operated by means of a treadle and levers.

Sewing Machine.—An apparatus for sewing fabrics by mechanical means. A suitable mechanism actuates a needle bar, reciprocating vertically, which carries a needle whose eye is situated at its point. The thread for this needle is supplied from a spool on the frame. The best machines make what is termed a *lock stitch*, a lower thread being carried by a horizontally reciprocating shuttle, which passes its thread through the loop of the thread carried through the cloth, by the eye pointed needle. The next upstroke of the needle pulls the bight of the lower thread taut, and thus, the stitch is the same on both sides of the fabric.

Sexagesimal Arithmetic.—Founded on the number sixty; proceeding by the powers of sixty; arithmetic in which sixty is the base of notation; as, in the sub-division of the hour or degree into minutes and seconds.

Sexagesimal System.—A system in which each unit is sixty times the next smaller one.

Sextant.—In navigation, an instrument, held in the hands, for measuring angles, more especially those made by the heavenly bodies, with the actual or an artificial horizon. Its limb extends about 60°, or one sixth of a circle, hence its name, but owing to the double reflection, the scale is graduated to 120° in a length of 60°. Colored glasses are fitted to be interposed for protection of the eyes from the glare of the sun, while the observer, looking through the telescope of the sextant, follows the upward movement of the heavenly body, moving an index mirror attached to a radial arm, so that the image of the sun, moon, or star, is kept on the horizon in another mirror. As the zenith is approached the radial

arm is clamped, and a vernier moved by a tangent screw; as soon as the sun, etc., begins to dip, the reading of the limb is taken through a microscope, this giving the true zenith distance. Adding this figure to the declination of the sun or moon, taken from the Nautical Almanac, gives the latitude.

Sextuple.—In arithmetic, six times as much; sixfold.

Shackle.—1. A link for coupling railway cars.

2. The bow of a padlock which passes through the staple.

3. Any one of various forms of fastenings.

Shackle Bolt.—A clevis or detachable link, shaped like the letter U, with a removable bar or fore lock passing through eyes at the extremity of each limb.

Shade.—1. Anything used to darken, obscure or divert light, whether the latter be artificial or natural; as, a window shade, to exclude sunlight, or a lamp shade to divert the light thrown upwards, and concentrate it on a table, etc.

2. The shadow or part sheltered from the sunlight or direct heat.

Shadow.—1. The dark figure or image projected by a body when it obstructs the light.

2. A profile or silhouette of each tool, painted on the walls of a store room, so that every article shall be restored to its proper place after use.

3. A frame or pattern corresponding to one of the cross sections of a boat or launch. The shadows are prepared from the drawings, and thus constitute templates, from which stock sizes may be built.

Shadow Line.—In mechanical drawing, a line about twice as thick as an ordinary line, representing the side of the object in shade. Also known as *shade line*.

Shaft.—1. A bar having one or more journals on which it rests and revolves, and intended to carry one or more wheels or other revolving parts; as, the shaft of a steam engine.

2. A chimney or smoke stack.

3. A tall tower.

4. That part of a blast furnace above the boshes, where the diameter remains the same.

5. In mining, a vertical or inclined excavation giving entrance to the mine.

Shaft Alley.—In ship building, a covered channel or passage through which the propeller shaft runs.

Shaft Alley, or Tunnel.—A passageway between the engine and stern of a ship giving access to the shaft, thrust bearings, etc.

Shaft Coupling.—A device employed to connect the different sections or lengths of which a line of shafting is composed. There are two classes, those that form permanent connections, such as, *flange, disc, plate, or compression* couplings, and those which effect engagement or disconnection between the various lengths at will, such as, *friction and jaw clutches*.

Shaft Drive.—Said of a motor car when the power is transmitted directly to the driving axle through gearing or a lay shaft, without the interposition of a chain.

Shaft Eye.—The bottom of a shaft in a coal mine; also the junction of a level and a shaft.

Shaft Furnace.—An upright smelting furnace, wherein the charge of ore and fuel is in intimate contact, as in a foundry cupola.

Shaft Governor.—A centrifugal governor for an engine, mounted on a pulley upon the crank shaft and revolving with it. Such a governor acts either by centrifugal force or by the inertia of its parts, and usually controls the travel of the slide valves in a steam engine, or the throttle valve in a gas engine.

Shafting.—Shafts taken collectively; as, a line of connected shafts.

Shafting Rest.—On a lathe, a rest usually employed in turning shafting. It carries several cutters.

Shaft Straightening Machine.—A device for truing bars and shafting preparatory to turning them, by means of a screw or hydraulic press exerting a thrust on the bent unsupported portions while the shaft is suspended upon blocks, etc.

Shake.—1. In paper making, a transverse vibratory motion imparted by a crank to the wire and rolls of the paper machine, to equalize the thickness of the pulp and also free it from water.

2. The crank and gear used to impart this motion to the machine.

Shaker.—In grain and flouring machinery, a vibrating screen or riddle worked by levers from a crank axle.

Shakes.—In carpentry, star shaped or circular cracks within a tree, probably caused by internal stresses set up by the expansion of the sapwood. The former, known as *heart* or *star* shakes, are not

particularly harmful to the timber, unless large, but the latter, in which one annual ring is wrenched from the next, are more serious.

Shake Willy.—In manufacturing, a willy or willowing machine for cleaning cotton, preparatory to carding.

Shaking Grates.—An arrangement of fire bars so pivoted that they may be shaken by the attendant, thus freeing them of ashes and clinker, dumping them into the ash pit. By this means slack, and cheaper forms of fuel, may be satisfactorily burned.

Shale.—In geology, a fine grained sedimentary rock of a thin laminated and often friable structure.

Shale Oil.—An oil extracted from shale when rich in bitumen, and other oil yielding substances, and extracted by distillation.

Shank.—1. Derived from a word in German, meaning a bone; hence, that part of an instrument, or other thing, which connects the acting part with a handle or other part, by which it is held or moved.

2. That part of a key, which is between the bow and the part which enters the wards of the lock.

3. That part of an anchor which is between the ring and the arms.

4. That part of a hoe, rake, knife, and the like, by which it is secured to a handle.

5. In founding, a long handle, T shaped at one end, by which two moulders carry ladles or crucibles, containing fluid metal, from the furnace to the mould; a large ladle fitted with a shank handle.

Shank Cutter.—An end mill; a cutter for a milling machine having its cutting edges disposed as a crown at the end of a long shank.

Shank Mill.—A milling machine cutter, which has a shank or stem.

Shaper.—1. In metal working, a form of planer in a lathe. The motion of the tool is in a line parallel with the axis of the arbor.

2. In sheet metal working, a striking or stamping machine for raising sheet metal.

3. In wood working, a machine for cutting moulding and irregular forms.

Shaping.—The act of imparting form to an object either by bending or moulding to a given shape or by removing superfluous material. The process of preparation of boiler plates, etc., is known as *shaping*; it includes shearing, edge planing and beveling. In machine shops, the term is applied to the machining of plane, concave or convex areas, by means of the *shaping machine*.

Shaping Machine.—A straight line cutting machine for metals, the reciprocating ram which carries the tool box being either driven by a crank, or by gearing similar to that of a planing machine. In large machines, the ram itself traverses the bed of the machine, the work remaining stationary; in small pillar shapers, the work table feeds across under the ram. A rotary feed can also be imparted to a spindle mounted on the frame; this serves to shape around double eyes or the forked ends of rods.

Share.—That part of a plow, generally made of chilled cast iron, which cuts the bottom of a furrow from the land beneath, and raises it in so doing.

Sharp.—Having a very thin edge or sharp point; terminating in a point or edge; keen; acute.

Sharpen.—To give a keen edge or fine point to; to make sharper; as, to *sharpen* an axe.

Sharp Sand.—Coarse grained sand, whose particles are angular; as, that obtained from lakes and rivers. Sea sand, by constant attrition, has rounded grains and therefore they slide over each other and do not possess the desired quality of binding in concrete.

Shave Hook.—In plumbing, a hand tool having a heart shaped scraper at the end of a convenient handle.

Shaving.—That which is shaved off; a thin slice pared off with a shave knife, plane, or other cutting instrument.

Shaving Knife.—A knife used by a currier in bringing leather to a fine smooth surface on the flesh side, and to a uniform thickness. This operation follows *skiving* or *splitting*.

Shaving Machine.—A hat maker's machine in which a rapidly vibrating knife removes long hairs from the pressed felt, before it is moulded into form.

Shavings.—Thin curly slices of wood removed with a plane or planing machine.

Shear.—1. To cut off; as, a beam or rivet.
2. To clip close with shears or scissors; as, shearing cloth.

Shearing.—The act or operation of clipping by shears or a shearing machine; as, the nap from cloth.

Shearing Machine.—1. A machine employed in boiler shops, bridge and ship-building yards, in which shearing knives

are driven by power, either through a belt, or by a separate motor or engine. They are used to cut off the rough edges of plates or to trim them to exact dimensions, the knives being set at an angle with each other, so that the cut takes place from one end to the other, as with a pair of scissors. Separate cutters are fitted to deal with bars, tees and angle irons, while one end of the machine is often constructed for punching holes in the metal.

2. A machine somewhat on the lines of a horse clipper, in which two serrated knives are moved radially over each other, by gearing driven from a flexible shaft attached to the handle. The apparatus is employed in shearing sheep, especially in Australia.

Shearing Strain.—In mechanics, a strain or change of shape or deformation of an elastic solid body, resulting from the operation of cutting with two sharpened edges which are caused to pass each other closely, like scissors.

Shearing Strength.—Equivalent to the force which, if steadily and slowly applied at right angles, or nearly so, to the line of axis of a rivet, causes it to separate into parts, which slide over each other, the planes of the surface at the point of separation being at right angles, or nearly so, to the axis of the rivet.

Shearing Stress.—The force resulting from the action of cutting across. Example, the rivets in a boiler are compelled to resist a shearing stress.

Shear Legs.—In erecting, a tripod crane of tall spars used for lifting heavy weights, adjusted by sliding the back leg in or out on a long screw.

Shears.—1. Any large cutting or clipping instrument worked by the crossing of cutting edges; a large pair of scissors, a pair exceeding six inches in length.

2. A shearing machine for cutting metal, usually operated by power; as, a *bar shears*.

3. In erecting, elevated spars connected at the upper end and used to elevate heavy bodies in a perpendicular position; as, masts, etc.

Shears of a Lathe.—The top slides of a lathe bed, on which the slide rest travels. The term is also applied to the lathe bed as a whole.

Shear Steel.—Carbon steel of fibrous nature, as used for edge tools or springs. It is made by fagoting or piling from blister steel.

Sheathing.—1. A skin or covering applied to an object for protection against corrosion, or to prevent the transfer of heat to or from neighboring substances.

2. A tightly fitting covering.

3. A skin of copper or Muntz metal, applied to vessels below the water line; it preserves wooden bottoms from worms, and ice.

4. The boarding forming the outside walls of a wooden building.

Sheathing Paper.—A thick paper, sometimes tarred or oiled, used for a lining between the inner and outer coverings of frame buildings, etc.

Sheave.—1. A pulley with a grooved rim over which a rope or chain passes; *sheaves* are placed singly or side by side within a wooden or metal frame, which is termed a *block*.

2. In a steam engine, the disc of an eccentric, which is used to actuate the slide valves of an engine.

Shed.—1. A small building slightly constructed and of simple form, usually one story high and often with the front or front and sides open; also a *lean-to*.

2. In a railway, a large, open structure, roofed against the weather, used for various purposes, such as to store merchandise or vehicles, or to shelter various operations, such as the exchange of passengers or goods, or engine cleaning.

3. In weaving, the double sloping aperture made of the threads of the warp, through which to drive the shuttle.

Sheep Shank.—A method of shortening a rope it is desired not to cut. The rope is folded into three parts, a hitch taken over each bight with the standing part, and all pulled taut.

Sheepskin Wheel.—A polishing wheel covered with leather made of sheepskin.

Sheer.—The curve given to the deck of a vessel raising it at bow and stern, thus adding reserve buoyancy at either end, making the decks drier, and improving the appearance of the ship.

Sheer Plan.—In shipbuilding, a term used incorrectly for a vertical longitudinal, midship section of a vessel, on which are projected various lines which in an architectural drawing would be known as an *elevation*.

Sheer Strake.—The paint strake of a vessel's hull; the upper strake of planking on a ship's side which follows the curve or sheer of the deck.

Sheet.—1. In navigation, a rope or chain attached to the clew of a sail in order to extend it. Lower square sails, or courses, have another rope, the *tack* attached to each clew, serving to haul forward and secure the weather corner of the sail, while the lee corner is hauled aft by the sheet.

2. A thin plate of metal and glass.

3. A broad piece of paper; also the same printed.

Sheet Anchor.—A spare anchor carried aft of the bowers, to be used in cases of emergency only; formerly it was the heaviest anchor in the ship.

Sheet Brass.—In metals, brass rolled into sheets and used for a variety of purposes, chiefly for ornament, covering steam domes, gauges, handrailings, instruments, etc. It is either *hard* or *soft*, according to requirements.

Sheeting.—1. Any material or fabric made so as to form a sheet.

2. A lining of timber or iron work, for the protection of the banks of a waterway. It may consist of timber or iron *sheet piling*, or of guide or gauge piles and planking, reinforced by bracing from the bank.

Sheet Iron.—The term "sheet," when applied to metals, means a sheet or plate not exceeding $\frac{3}{16}$ ths of an inch in thickness, and when applied to glass, means a sheet or plate not exceeding $\frac{1}{4}$ th of an inch in thickness. "Plate" means, when applied to metals, a plate or sheet more than $\frac{3}{16}$ ths of an inch in thickness, and when applied to glass, means a plate or sheet more than $\frac{1}{4}$ th of an inch in thickness.

Sheet Lead.—In metals, used for various purposes, especially by plumbers, also for lining up small patterns.

Sheet Metal.—Brass, copper, zinc, etc., rolled into sheets or thin plates. By common usage, if the thickness exceeds $\frac{3}{16}$ ths inch or so, the material is termed a *plate*.

Sheet Metal Gauge.—An instrument employed to measure the thickness of sheets of metal, usually denoting the various thicknesses by a range of successive numbers.

Sheet Mill.—A rolling mill, devoted to the production of sheet iron or steel.

Sheet Piling.—Timbers, piles, or plates of metal or reinforced concrete, driven firmly, side by side in rows, into the earth along the shores of a body of water. The object of sheet piling, is either to exclude water or to protect the bank from caving.

Sheet Tin.—In metals, sheet iron coated with tin. It is used by engineers in the making of the lightest kinds of templates, etc.

Shelf.—1. A flat tablet or ledge of any material set horizontally at a distance from the floor, to hold objects of use or ornament.

2. A sand bank in the sea, or a rock or ledge of rocks, rendering the water shallow.

Shelf Bracket.—A device for supporting a shelf.

Shell.—1. The outer covering, husk, or hard external crust or skin of anything; the stony or bony covering or protection of certain animals.

2. The outer skin or external part of any object, more especially of a boiler, considered apart from its fittings, mountings, etc., or of a ship, regarded without consideration of her machinery, rigging, or fittings.

3. Any slight or hollow structure, destined to be filled in, or constructed in that manner for the sake of lightness.

Shellac.—A gum or resin imported from India and Ceylon. It is gathered from the twigs of various trees on which it has been deposited by the female of the lac insect, which secretes it to hold her eggs in place. (The name is probably derived from lakh, 100,000, the number in one nest.) After preliminary operations, the gum is melted, strained through cotton bags upon metal plates, where it assumes its familiar flaky appearance. It is used for sealing wax, as a cement, and as a foundation for varnishes. It is also much used by pattern makers.

Shellac Varnish.—A spirit varnish, in which gum shellac is dissolved in alcohol with coloring matter added. It hardens by evaporation of the spirit, and is unsuitable for exposed or outdoor work; engineers usually employ it for coating patterns.

Shell Auger.—An auger in which the cutting part is shaped as a semi-cylinder, similar to a spoon bit or gimlet; also called *screw auger*.

Shell Bit.—In carpentry, a wood boring tool having a large hollow receptacle for the chips. It is used in boring timbers for pump stocks and wooden pipes.

Shell Calipers.—Special calipers, used to measure the thickness of metal in a shell; it consists of a beam with one fixed trammel forming a try square, while the sliding trammel is furnished with a fine wire pointer which may be set and locked by adjusting screws.

Shell Mill.—A wide milling cutter, bored to fit on a mandrel or arbor.

Shell Plate.—The chief or external plating of a boiler, the walls or envelope of a cylindrical boiler.

Shell Plating.—The external plating or skin of the hull of a ship.

Shell Reamer.—A reamer bored out hollow for mounting on a mandrel or arbor.

Shelter Deck.—A complete erection, fore and aft, on a three decked ship, with openings unprovided with means of battening down. This unenclosed space is exempted from the gross tonnage of the vessel, and adds greatly to the reserve buoyancy and structural strength. It is much used in cattle carrying boats.

Sheth.—The part of a plow which projects downward beneath the beam, for holding the share and other working parts; also called *standard* or *post*.

Shield.—In mining and tunneling, a framework used to protect workmen in making an *adit* underground, and capable of being pushed along as the excavation progresses.

Shift.—1. A number or body of men acting as relays or working alternately with another body carrying on the same work; as, a day shift, a night shift.

2. The period of time through which such a relay works.

3. In mining, a slight fault or dislocation of the strata.

Shift Boss.—The foreman or person in charge of a shift of work people.

Shifting Lever.—The lever by which clutches are thrown into gear or disengaged, or by which a belt is moved from a tight to a loose pulley, or *vice versa*.

Shifting Spanner.—An adjustable wrench, the jaws being moved apart, or closer together, by means of a milled screw.

Shift Key.—That lever in a typewriting machine, which being depressed, causes the machine to print capital letters, thus obviating special keys for those characters. Also called *upper case*.

Shilly Shally.—A shop term indicating irresolution; hesitation; also, occupation with trifles.

Shim.—1. A piece of wood or iron inserted in a defective place to fill out to a fair surface.

2. To hold in position by means of a shim.

Shimer Heads.—On wood working machines, a type of cutter head used with circular cutters.

Shine.—Brightness; luster; gloss; polish; to brighten by rubbing or polishing; as, to shine the engine brasses.

Shingle.—Accumulations of rounded stones, worn by the prolonged action of water in motion; the masses of angular or sharp stones being known as gravel; the former is found on sea beaches, the latter on the banks of lakes and rivers.

Shingled Bloom.—In smelting, a term applied to the ball of crude malleable iron which has been subjected to the process of *shingling*, preparatory to rolling it into a slab or puddled bar.

Shingle Mill.—A saw mill for cutting logs into shingles.

Shingle Nail.—A cut nail of proper size for fastening shingles on a roof; a six-penny nail.

Shingler.—The ironworker who shingles wrought iron blooms under the steam hammer, at a squeezer or crocodile jaws.

Shingles.—1. Sawed or split pieces of wood used as roofing material; the woods employed being cypress, redwood or cedar. Cedar and redwood shingles are usually 16" long by $\frac{5}{8}$ " or $\frac{1}{2}$ " thick at the butt; cypress, 18" long by $\frac{3}{4}$ " thick at the butt; in each case the widths being random, that is, varying from 3" to 14". Common shingles are put up in bundles, four to the "thousand," a "thousand" equaling the width of one thousand four inch shingles. Picked shingles of a standard width, either 4", 5", or 6", are also sold as *dimensioned shingles* at a slightly higher price, the butts being often formed to a pattern. In laying shingles, it is unwise to expose more than from 4 to 5 inches of 16" cedar or redwood, or more than 5 to 6 inches of 18" cypress.

2. Boards of a V section, commonly $\frac{1}{2}$ " to 1" thick at one edge and tapering towards the other, made from some wood which splits easily along the grain, such as certain pines or oaks; used as a fencing or roofing material.

Shingle Saw.—A machine by which shingles are sawed from suitable blocks, a feed mechanism being provided whereby the butts are alternately cut from opposite ends of the block; in addition to the circular saw, a *jointer* is sometimes placed on the same frame to true the edges of the shingles.

Shingling.—Forcing the slag from a bloom of wrought iron after it has left the puddling furnace. Originally *helves* and *tilt hammers* were employed, but have been superseded by the steam hammer, although *alligator* or *crocodile squeezers*, with serrated jaws, have proved efficacious in cleansing the impurities, by compressing the bloom, as a sponge in the hand.

Ship.—Properly a three masted vessel, square rigged on each mast.

Ship Canal.—A canal suitable for the passage of seagoing vessels.

Ship Chandler.—A trader who supplies shipping with their furniture, stores and supplies. Provisions and coal are regarded as a separate department of business.

Ship Jack.—A compact and portable form of hydraulic jack adapted for lifting ships and other heavy objects; the number required being proportioned to the weight.

Shipment.—1. The act or process of shipping; as, of machinery.

2. That which is shipped; as, a lathe on an order from abroad.

Shipping.—1. Mercantile vessels generally; the general body of craft of all descriptions belonging to or engaged in waterborne traffic to or from any particular port or nation.

2. Matters relative to the mercantile marine; their ownership, navigation, employment, etc.

Ship's Ballast Tank.—The compartment for water to be pumped in and out for the purpose of insuring the proper draft of the vessel.

Ship's Capstan.—A form of capstan which is used on shipboard for warping, boat hoisting, and other purposes.

Shipshape.—Being in good order as be comes a ship, well arranged; orderly.

Ship's Hoist.—In rigging, an engine and boiler attached to a carriage or truck running on wheels, used for the general and miscellaneous work where power is required on board ship.

Ship's Husband.—The official whose duty it is to see that a ship is kept in proper repair and that all necessary stores and gear are supplied. The term

is dying out, such official being usually referred to as *marine superintendent*. Sometimes called *port captain*.

Ship's Log.—1. A journal of proceedings and observations on shipboard.

2. An instrument for measuring the speed through the water.

Ship's Pump.—A bucket pump fitted to sailing vessels, according to law, so that the wells in the lower part of the hull may be kept free from water. Sometimes these pumps are fitted with a windmill, to lighten the labor of the crew.

Shipwright.—A builder of wooden vessels; one who executes carpentry or framing work in shipbuilding, as distinguished from the *joiner* who fits up the accommodation; a *ship's carpenter*.

Shipyard.—A yard, place or enclosure where ships are built or repaired.

Shirk.—A shop term, meaning one who avoids the performance of duty or labor.

Shives.—Splinters, fragments, more especially the woody fragments of the flax plant removed by breaking.

Shoal.—A shallow place in the sea; of little depth.

Shock.—Strain imposed by impact or percussive action; effects produced by a sudden blow or jerk; a jolt or jar.

Shock Absorber.—A spring device attached to the spring horns or hangers of motor cars, whereby the shocks and jars due to rough roads are dissipated instead of being transmitted to the frame of the carriage.

Shoddy.—In manufacturing, a cloth made from worn woolen rags. These are torn to pieces by a machine having spiked rollers, termed a *devil*, cleansed, and the fiber spun with a certain proportion of new wool, the yarn being afterwards woven into the full bodied but flimsy fabric termed *shoddy*.

Shoe.—1. A covering for the foot, hence, by extension, anything that protects the lower extremity of any part of a structure or mechanism.

2. The enlargement of, or addition to, a piston rod crosshead, which presses on the guide bars, and undergoes the wear due to friction. (This is also termed *slipper*, either from the name, notion or conception, or because it slips on the guides.)

3. The protective iron point attached to a pile to save it from damage, and cause it to enter the ground easily.

4. The removable tip of an ore crushing stamp.

5. The shaking spout below the hopper, which feeds the grain into a pair of millstones; the shoe is shaken by the *damsel* on the spindle.

6. That part of a brake, which is applied to the tire of a vehicle.

7. In mechanics, a socket to take the thrust of a truss rod, or that of the ends of shear legs.

8. The pivot bearing of the upright post of a jib or derrick crane.

Sholes, Christopher Latham.—Born 1819, died 1890. An American inventor, called "the father of the typewriter."

At first a journalist, he was led, by reading of the efforts of John Pratt, to study the possibilities of writing machines. In 1867, he brought out the first crude instrument, which, by constant improvement, became a marketable typewriter in 1873. The Remington Arms Co., of Ilion, N. Y., undertook the manufacture of the article, and by incorporating further improvements devised by the inventor, perfected the well known typewriter now bearing the manufacturer's name.

Sholes.—In erecting, wedges, etc., under the heels of shores.

Shook.—A package containing the staves and heading of a cask ready to set up. The materials for a cask are thus placed, ready prepared, in a compact form for transportation; as, casks are shipped in *shooks* to Africa for palm oil.

Shoot.—1. In mining, to blast with gunpowder or other explosive.

2. In weaving, to cast or throw the shuttle.

Shoot a Well.—The practice of exploding a torpedo, containing a quantity of nitroglycerin at the foot of a drilled petroleum well, in order to break up the surrounding rock and insure a larger production. A number of long, tin cylinders containing the explosive, to the amount often of fifty or sixty quarts, is lowered to the bottom of the well, and therein exploded by dropping on them from above, an iron weight or *go devil*, or a small tin of nitroglycerin, known as a *squib*, which is fitted with a time fuse.

Shooting Board.—In carpentry, a fixture used in planing, or shooting, the edge of a board by means of which the plane is guided and the board held true.

Shooting Needle.—In mining, the same as *stemmer* or *blasting needle*.

Shooting Plane.—A side plane used in connection with the shooting board, for squaring or beveling the edges of stuff.

Shop.—A room, building, or department in which the manufacture, construction

or repair of any article is carried on, generally deriving its name from the particular operations therein performed, as *blacksmith's shop*, *machine shop*, or from the articles produced, as *pattern shop*.

Shop Drawings.—Copies or tracings of drawings made for the use of workmen.

Shop Pan.—A long shallow metal pan usually placed under lathes to catch the cuttings.

Shop Tools.—Small tools and appliances provided for the general use of the workmen in any particular department. The term would not be held to include machinery, but would comprise gauges, large straight edges and squares, stocks, dies and taps, surface plates, ladders, trestles, sieves, shovels, etc., provided for the common use of all.

Shop Work.—Work executed in a shop, as distinguished from *outside work*.

Shore.—1. In carpentry, an upright or slanting strut or brace, the upper end of which presses against the object supported.

2. The margin or edge of the land; land adjacent to a river, lake or sea; the coast.

Short.—A term signifying brittle, when applied to metals, especially iron or steel. Iron or steel, when brittle below a dull red heat, is termed *cold short*. When the metals cannot easily be wrought at or above a red heat, they are said to be *hot short*.

Shortage.—A deficiency; the amount by which anything is deficient from a certain standard, or by which the supply falls below the demand.

Short Division.—In arithmetic, a process of division where the continued subtraction is effected mentally, the quotient alone being set down, without any working. The opposite to *long division*.

Short Pile.—In hydraulics, a stick of round timber from six to nine inches in diameter and from six to twelve feet long. They are driven as closely as possible without causing the driving of one pile to raise the adjacent ones. They are used to compress and consolidate ground for foundations.

Shot.—1. In weaving, a single thread of the woof cast through the web by the shuttle.

2. A fabric, usually silk, in which the colors appear changeable by having all the warp threads one color and all the filling another.

Shot Drill.—An earth boring drill using shot as an abrasive, somewhat after the manner of a diamond drill.

Shot Tower.—A tall building used in the manufacture of lead shot. The lead is melted in a furnace at the upper part of the tower, and poured into a bath with a perforated bottom, whence it falls into tanks of water at the tower foot, the drops solidifying into shot. The diameter of the pellets is regulated by the height from which they fall, and the sizes of the holes in the colander. After cooling, the shot are sorted over for defective ones, the principle being that of letting them run down a slightly inclined table with a transverse groove. Perfect shot leap the groove, defective ones, not being spherical, fall within it, and are run off at one side. Afterwards the perfect shot are separated for size, by means of sieves, and are finished off with blacklead in a tumbling barrel to blacken and polish them.

Shoulder.—1. Any projection or contour which resembles in outline or position the human shoulder, as the *shoulder* of a hill, the *shoulder* of a bastion.

2. In machine shop practice, an abrupt change of diameter in a shaft spindle or bolt forming an abutment for the part penetrated by the smaller diameter.

Shove.—1. The act of pushing or shoving; a strong push; as, to give one a *shove*.

2. The central woody portion of the stem of the flax plant.

Shovel.—An instrument consisting of a broad scoop or blade, more or less hollow, with a handle, used for throwing coal, earth or similar loose substances.

Shred.—1. A strip, piece or fragment; one of the minute parts into which anything may be resolved by tearing, cutting or explosion.

2. To cut, or tear into strips or small fragments; the term conveys the idea of tearing apart.

Shredder.—A machine for reducing substances to shreds or strips in the course of their preparation. The usual type has teeth or knives set in longitudinal or spiral rows upon a cylinder or drum, which presses against bars, or a grating.

Shrink.—1. To contract or become of lessened dimensions. To shrivel up or become small.

2. To secure an external piece on an internal by the aid of expansion. The hoop, liner or sleeve is first bored slightly smaller than the male part, is heated to a moderate temperature and then, while expanded by the heat, is slipped or gently forced in place, the contraction on cooling, causing it to grip its seat firmly. Used for wheel tires, pump pistons, etc.

3. To contract in lineal dimensions, as all metals do, except certain alloys of bismuth, in cooling from their fusion point to a solid state.

Shrinkage.—In founding, this term is usually applied to the diminution of volume of the melted metal as it solidifies; contraction is applied to its further decrease in size as it cools to normal temperature.

Shrinkage Fit.—In workshop practice, a variety of force fit, in which the hub or eye requires to be heated before the shaft can be inserted, as in fitting a tire on the wheel of a railway vehicle; the contraction of the external part as it cools, firmly gripping the internal piece.

Shrinkage Rule.—A pattern maker's rule made with all the graduations larger than they should be in the proper proportions, to provide allowance for the contraction of the molten metal, on cooling. Rules are made single or double contraction, the latter being necessary when an iron pattern has to be made from the original wooden one. Also called contraction rule.

Shrink Holes.—In founding, a hole occasioned in the casting through those parts which solidify first drawing metal from the parts solidifying later. A shrink hole is generally rough, while a blow hole is smooth. More trouble is experienced from this cause with hard than soft irons.

Shroud.—1. One of a pair or set of stay-ropes or chains to give lateral support to a topmast, bowsprit or the like.

2. A chain to brace a steamer's smoke-stack.

3. A guy. All usually spoken of in the plural as *shrouds*.

Shrouding.—A term applied to the metallic covering over boiler lagging; the external funnel; a plate fixed on uptakes and smoke box doors with an intervening air space to prevent their burning; the stiffening ring at the side of the teeth of gear wheels, etc.

Shunt.—In railway service, a term signifying to switch off a car or train from the main to a side track.

Shunter's Pole.—A stick used on English railways in the coupling or uncoupling of freight cars. It has a hook at one end, to hold the coupling chain, being used with the side buffer as fulcrum to lift the link off the hook, or vice versa.

Shunting Engine.—A locomotive used in the operation of switching; that is, sorting and marshaling cars at railway depots. Also called *switch engine*.

Shut.—To close; hence, in mechanics, to weld one piece on another. A *cold-shut* is an imperfection in a casting where two streams of metal, through cooling, fail to unite properly, lying on or against each other instead of coalescing; fracture is always liable at such a point.

Shutters.—Panels, usually of wood, but sometimes of other material, which are hinged to a window frame, or may be placed therein, with the object of excluding light or of closing the window so that the interior may not be seen from outside.

Shuttle.—1. A boat shaped thread holder, which carries the lower thread in a sewing machine for making the lock stitch.

2. In weaving, an instrument coned at each end, which is hollowed out to contain the pirn with the woof or filling, which it carries from one side to the other of the loom, between the threads of the warp, thus making the *shoot* or *pick*.

Shuttle Box.—In weaving, a receptacle on the loom for holding shuttles with the different colored threads used in the pattern, their service being regulated by the pattern chain.

Shuttle Check.—In weaving, a device for checking the recoil of the shuttle after it has been struck by the picker-staff.

Shuttle Race.—In weaving, etc., the track or run along which the shuttle travels in a loom or sewing machine.

Shuttle Service.—In machinery, the work done by an instrument used in weaving, for passing or shooting the thread of the *woof* from one side of the cloth to the other, between the threads of the *warp*.

Shuttle Winder.—A machine or device for winding threads upon bobbins, spools or pirns, so that they may be used in shuttles.

Siamese Connection.—In a steam fire engine, a Y or V shaped hose connection to standpipes outside a building, so that two lines of hose may be connected to one pipe.

Sic.—Thus; so; a word inserted in parentheses; as, (*sic*), in writing, to indicate that the quotation is a literal transcript.

Sick Bay.—In navigation, an apartment on board of a ship where sick sailors are kept.

Sickening.—In gold mining, said of mercury when its surface becomes dulled or "flowed" over, rendering it incapable of amalgamating more gold. The phenomenon is generally caused by sulphur, arsenic or tellurium in the gold, and may be mitigated by adding a small percentage of sodium to the mercury.

Side.—One of the longer edges of an object, as distinguished from the shorter edges, called *ends*.

Side Brackets.—Lugs, brackets or knees used to support the shell of an externally fired return tube boiler upon the brickwork surrounding its furnace.

Side Chains.—In a locomotive, a device consisting of three or four links and a hook, placed each side of the central coupling, as a precautionary measure.

Side Chisel.—A chisel, used by machinists, having its cutting edge on one side of the end facet.

Side Discharge Water Wheel.—One which receives its water at the center and discharges it through an opening in the casing around its periphery. Better known as a *radial outward flow turbine*.

Side Elevation.—In drawing, a view on a drawing which shows the side of a structure.

Side Lever.—1. On a marine inverted beam engine, a *side lever* on either side of the engine, driven by double connecting rods from the piston crosshead, and itself driving the crank through a connecting rod at the opposite end of the beams.

2. A tiller for steering a motor vehicle, placed at the side of the driver's position.

Side Light.—In a vessel, the red or green signal lights exhibited to port or starboard.

Side Play.—1. Provision for longitudinal movement; as, of a shaft in its bearings, or of a working part on the shaft; it is advisable and necessary, so as to permit the parts to adjust themselves while running.

2. In a locomotive, the space allowed between the hubs of the wheels and the axle boxes. It is generally from $\frac{1}{8}$ " to $\frac{1}{4}$ ", but the carrying wheels of locomotives, having long, rigid wheel base, are given $\frac{1}{4}$ " play to either side, between the journal box flanges and the pedestals, thus permitting $\frac{1}{2}$ " movement in all.

Side Pond.—In hydraulic engineering, a device for economizing water when locking barges on a canal. The side pond is a reservoir, usually on either side of the lock, and when *locking down*, one fourth of the water in the lock is run into one reservoir, and the next fourth into the other, the remaining half of the water is run out by sluices in the gates. When *locking up*, as soon as the gates are closed, the side ponds are successively opened, thus half filling the lock once more, the remainder being filled from the upper level, in the usual manner. By these means, half the waste of locking is prevented.

Side Rake.—In machine shop practice, the rake or inclination of the edges of a tool which cuts sidewise, either to the right or left. Such rake may be side top rake or side bottom rake, according to whether it describes the slant of the upper surface or the angle of clearance or relief beneath the cutting edge.

Sidereal.—In navigation, of or pertaining to the fixed stars. *Sidereal time* is measured by the apparent diurnal motion over the stars, the sidereal day being measured by the apparent passage over the meridian of the first point of Aries, or first point of right ascension. This is the only correct standard whereby time can be measured.

Side Rods.—In a locomotive, etc., the parallel rods that couple the various driving wheels.

Side Slip.—A sidewise skidding and slowing of bicycles and motor cars in rounding curves, owing to slight adhesion between the tires and the surface of the roadway.

Side Spring.—A peculiar type of spring at either side of the frame of a light runabout motor car, the spring extending from one axle to the other.

Side Steering.—In a motor vehicle, steering by means of a tiller or lever at the side of the driver's seat.

Side Tension.—A jockey pulley or tightener for rope drives, used to maintain the proper tension on small horizontal

drives. The track or guide for the tension carriage is set horizontally and edgewise to a wall or column, thus differing from the usual vertical patterns.

Side Tool.—In machine shop practice, a lathe tool designed to operate on the side of collars, etc.; it is shaped like a straight or diamond point roughing tool, and is cranked to the right or left hand, according to the side on which it is desired to operate.

Siding.—1. A short length of railway running beside the main line, and connected therewith by means of switches. A siding serves for the accommodation of slow trains, which may have to shunt for the passage of faster ones overtaking them, or for handling wayside or local freight traffic at intermediate points, where there is insufficient passenger traffic to warrant the expenses of a station. In the plural, the term denotes the auxiliary lines in a depot for car storage, freight handling, marshaling, shunting, etc., as differentiated from the running lines. Also known as *side track*.

2. The planks or boards used to sheath a wooden building.

Siemens, Sir William.—Born 1823, died 1883. A German-English metallurgist and electrician. He first visited England in 1843 to introduce a chronometric governor for steam engines and the process of anastatic printing; settling in England, he patented a regenerative steam engine and condenser (1847), a water meter (1851), and organized a company for the manufacture of steel; he became London agent for the German electrical firm of Siemens and Halske, and played an important part in the development of electric lighting and traction in England; he laid an Atlantic cable from a ship specially designed by him (1874-75); he invented the electric furnace (1879), the pyrometer, the bathometer, taking out in all 113 patents; he became president of four leading English engineering societies, received many honors and distinctions, culminating in knighthood the year of his death.

Siemens Furnace.—In steel making, a combination of a Siemens gas producer with a regenerator for heating the blast, and an open hearth furnace for melting the steel.

Siemens-Martin Converter.—A reverberatory furnace, with a bowl shaped hearth, in which pig iron is melted with ore, steel scrap, etc., to form steel. It differs from the Bessemer process, in that the air, to oxidize silicon and burn off the carbon, passes over the molten metal instead of through it. Samples of metal are taken at intervals for testing, and when sufficiently decarbonized, spiegel elsen or ferro manganese is added to make the desired percentage. The resulting metal is a fine homogenous steel of uniform quality, suitable for boiler plates and intricate forgings.

Siemens-Martin Steel.—Mild or low carbon steel, made by the open hearth process, from ore, pig iron and steel scrap.

Sieve.—In flour milling, a tray or box, circular or rectangular in shape, with a bottom of woven netting, generally of iron wire, by means of which the operation of sifting is carried on.

Sieve Scalper.—The first scalper for preliminary separation in a flour mill, having sieves nearly horizontal.

Sift.—To separate the fine from the coarse parts of a material by the use of a sieve, the smaller passing through the meshes, while the larger are retained. The process is accelerated by shaking the sieve either by hand or power.

Sight.—The faculty of vision; the power of viewing material objects through reflection of light rays from their surfaces, the rays focusing upon the retina of the eye, and, by aid of the delicate sensory apparatus, becoming imaged in the brain.

Sight Box.—A glass sided compartment, placed at the front of each manifold or separator in the tail or sampling house of a petroleum refinery. The attendant is able to see the distillate from the stills flow into the manifold, in order that he may direct it into its proper pipe, according to its gravity.

Sight Feed Cup.—A lubricator, whose supply of oil to a bearing is visible, either dripping from the holder into the open end of the oil pipe or else being fed through water in a glass tube.

Sight Feed Lubricator.—In a locomotive, one that passes the oil visibly, drop by drop, through a section of glass tube so that its rate of supply may be observed. The term is usually applied to those types in which the condensation of steam displaces oil from a vessel under pressure, the weight of the column of water plus the steam pressure forcing the drops of lubricant along pipes to the desired spot. Locomotives usually have a lubricator fitted with sight feed glasses and supply pipes leading to each cylinder and also to the air brake.

Sight Lines.—Guide lines placed on a perspective drawing to guide a draftsman as to the direction or angle in which the object is supposed to be viewed.

Signal.—A token; an indication; a sign which has been agreed upon to give notice of some occurrence to a person at a distance.

Signal Code.—A pre-arranged system of combinations of flags, semaphores, or lamp flashes, which indicate numerals, words, or phrases, and thus enable communication to be carried on.

Signal Cord.—A communication cord in passenger cars, used in connection with the air brakes and signal whistle.

Signal Light.—A term applied to the navigation lights of a ship; as, masthead, side and stern lights.

Signalman.—The attendant in a signal tower, who directs the movement of trains by semaphore or other signals, at the same time manipulating such switches as are necessary.

Signal Oil.—A mineral oil suitable for burning in the lamps of railway signals.

Signal Whistle.—A means of communication in railway trains. A small pipe, the length of the train, is charged with compressed air through a reducing valve, at a lower pressure than that used for the brakes; pulling the signal cord in any car opens the car valve, and the reduction of pressure in the signal pipe causes air to pass the "signal valve" on the locomotive, blowing a small whistle in the cab.

Signature.—The name of any person, written with his own hand; a sign manual; an autograph.

Signs.—Characters indicating the relation of quantities, or an operation performed upon them; as, the sign + (plus) is prefixed to a quantity to indicate that the quantity is to be added, and the sign — (minus), to denote that the quantity to which it is prefixed is to be subtracted.

Signs Showing the Power of Numbers.—A small figure raised at the right of a number shows the power to which it is raised, thus:

8^2 is equal to $8 \times 8 = 64$; that is, 64 is the square of 8.

5^3 is equal to $5 \times 5 \times 5 = 125$; that is, 125 is the cube of 5.

4^4 is equal to $4 \times 4 \times 4 \times 4 = 256$; that is, 256 is the fourth power of 4.

Signs that Represent the Roots of Numbers.—The sign common to all roots is $\sqrt{\quad}$ and is known as the radical sign. If we require to express

the square root of a number, we put this sign before it: as, $\sqrt{16}$, but if the number be made up of two or more terms, then we express the square root by the same in front, but with a line as far as the square root extends; as, $\sqrt{9+7}$ or $\sqrt{4(19+6)}$.

The cube root is expressed by the same sign, with a 3 in the elbow; as, $\sqrt[3]{8}$ or $\sqrt[3]{7(100-51)}$. All other roots in the same manner, the number of the root being put instead of the 3; as, fifth root $\sqrt[5]{\quad}$, and sixth root $\sqrt[6]{\quad}$.

The other way of expressing that the root is required, is by putting a fraction after and above the quantity; as, $16^{\frac{1}{2}}$, which means the square root of 16, $(19+17)^{\frac{1}{2}}$, or $\frac{1}{4}(19+6)^{\frac{1}{2}}$, all of which mean the square root of the quantities to which they are attached. The cube root, 4th root, 5th root, etc., are written in the same way; as, $729^{\frac{1}{3}} = 9$; $256^{\frac{1}{4}} = 4$; $3125^{\frac{1}{5}} = 5$; etc.

N.B.— $\sqrt{\quad}$ is a corruption of radix, a root.

Silencer.—1. A device for silencing the noise of the exhaust from an internal combustion engine, by muffling and cooling the gases until they have condensed approximately to near their original volume; also called *muffler*.

2. A device fitted to the end of a gun barrel, to muffle the noise when fired.

Silent Feed.—In saw milling, a piece of mechanism by which the logs are fed forward to the saw in deal and timber frames. It is used in preference to the ratchet and *click*, by reason of its freedom from noise. It consists of an adaptation of a nipping lever carried at the end of a radial arm, whose length can be varied to suit different amounts of feed.

Silex.—In chemistry, an oxide of silicon. It occurs nearly pure in quartz rock, chalcedony, flint, and in various other more or less impure forms; it constitutes an important part of the earth's crust; also called *silica*.

Silica.—In chemistry, an oxide of silicon, known also as *silex*.

Silica Bricks.—In brick making, fire bricks whose main constituent is silica. The rock which furnishes the silica is ground, crushed and mixed with lime and water, then moulded and burned. They are used for the roofs of furnaces, being set in *silica cement*. They are unsuitable for those hearths and other furnace linings, where they would come in contact with metallic oxides. For those situations, *aluminous bricks* are employed.

Silicate.—In chemistry, a *salt* of silicic acid.

Silicate Cotton.—A mineral fiber similar to spun glass, formed by blowing an air blast through a stream of molten slag; also called *mineral wool*. It is used as a non-conductor on boilers, etc., and as an insulating packing in cold storage buildings.

Silicon.—Also called *silicium*. A non-metallic element, widely diffused through nature, forming in various compounds most of the rocks constituting the earth's crust. Its name is derived from the Latin, *silex*, a flint, a familiar manifestation. A small quantity added to copper deprives it of oxygen, improving it for telegraph or telephone wire. In cast iron, it increases hardness, and with cast steel, a small percentage favors the expulsion of gases and promotes sound castings free from blow holes. In its most usual form as silica or silicon dioxide, it forms the ruby, the quartz of the mountain, and the sand of the seashore.

Silicon Bronze.—An alloy of copper and silicon, with or without tin. Silicon gives to copper great strength and toughness, used for telegraph and telephone wires, principally in German and Austrian cities.

Silk.—1. The fine soft thread produced by various species of caterpillars in forming the cocoons within which the worm is enclosed during its earlier stage of life.

2. Thread spun or cloth woven from the above named material. *Raw silk* is silk as it is wound off from the cocoons, and before it is manufactured.

Silk Dresser.—A bolting machine for flour, provided with silk screens or bolting cloths, through which the flour is sifted.

Silk Filature.—1. The process of winding silk threads from the cocoon of the insect.

2. Silk threads so wound.

Sill.—1. In carpentry, a part of a foundation of a structure of any kind; as, a door sill.

2. A timber in the frame of the floor of a railway car; as, an *end sill*.

3. A wooden beam used as a support or foundation for any machinery operating in the open.

4. In a locomotive tender, one of the wooden or steel beams forming part of the frame.

Silo.—A pit or chamber underground, or occasionally a warm air tight compartment above ground, in which green food, etc., is stored for future use. The fodder is placed in layers, sometimes sprinkled with salt, and always subjected to pressure. The slight fermentation which ensues is beneficial rather than the reverse, and cattle eat the fodder with avidity.

Silt.—A very fine sedimentary deposit of sand and clay from running or standing water; the slimy mud deposited in the mouths of rivers, tending to choke them.

Silver.—A precious metal of a white lustrous appearance, having a specific gravity of 10.56 and a melting point of 1738° Fahr. It is soft and can be beaten out into extremely thin leaves (*silver leaf*); it requires the addition of copper to make it hard enough for general use; as, *sterling silver*, consisting of .925 silver and .075 copper. The metal does not oxidize at any temperature in the air, but it is blackened by sulphuretted hydrogen, hence, polished silver articles tarnish when exposed to the air. Silver is found free in various parts of the world; as a chloride or horn silver and in various sulphides.

Silver Grain.—In timber, the rays which radiate from the heart to the bark. The position of the silver grain is important as affecting the shrinkage, which takes place chiefly in a direction transversely to the course of its rays.

Silvering.—The process of coating glass with a film of silver in making mirrors.

Silver Plated.—Covered with a coating of silver, either by electro-deposition or by the old mercurial process.

Silversmith.—One whose occupation is to manufacture utensils, ornaments, etc., of silver; a worker in silver.

Silver Solder.—Hard solder is made by adding one part brass wire filings to three parts of sterling silver. Soft silver solder is composed of two parts of silver to one part of brass filings.

Silver Steel.—In metallurgy, at one time, about two per cent. of silver was added to fine cutlery steel, with the idea of improving its qualities. The name is still applied to the highest grade of *razor temper* tool steel.

Simblot.—In weaving, the harness of a drawloom.

Simple.—1. In chemistry, not capable of being decomposed into anything more simple or ultimate by any means at present known; elementary; thus, *atoms* are regarded as simple bodies.

2. In minerals, homogeneous, alike through all its parts.

3. In weaving, a drawloom. A part of the apparatus used for raising the heddles of a drawloom.

Simple Equation.—In algebra, an equation containing but one unknown quantity, and that quantity only in the first degree.

Simultaneous.—Existing, happening or done at the same time.

Sin.—An abbreviation of the trigonometrical term, *sine*.

Sine of an Angle, or an Arc.—A term used in geometry; a line drawn from one end of an arc, perpendicular to a diameter drawn through the other end.

Singe.—1. To burn slightly; to discolor by burning.

2. In calico manufacture, to remove the nap of; as, calico, in order to prepare it for printing or dyeing, by passing it rapidly over a red hot bar, or through a flame, as of gas.

Singer.—In manufacturing, an apparatus through which cotton or woollen goods are passed to relieve them of their fluff, preparing them for the dryer. The capacity of a *braided singer* is 10,000 yards per hour.

Single.—1. Individual; separate; solitary.

2. Uncombined with others or with anything else; unmixed.

Single Acting.—Restricted to one motion or operation; capable of exerting power in one direction only; as, a single acting engine.

Single Acting Engine.—One in which the impulse is given on one side of the piston only; the usual type for internal combustion engines, and one sometimes employed for high speed steam engines.

Single Acting Pump.—One doing effective work in only one direction of piston stroke; a pump having a reciprocating or back and forth motion of the piston, but doing work in one direction only.

Single Action Ratchet Brace.—A brace of the ordinary description, working in a clockwise direction only, as differentiated from that type provided with reversible pawls.

Single Belting.—Leather belting made in one thickness or ply, such as is used for driving small machines. The thickness is usually taken as $\frac{3}{4}$ " or $\frac{1}{4}$ ".

Single Chain Drive.—In a motor vehicle, transmission of power to the driving axle by means of a single chain, running either from the change speed gear, or else directly from the engine shaft.

Single Crank.—In a steam engine, an overhung crank.

Single Cut File.—A file having single lines of cutting teeth only, as distinguished from *double cut* files, or those with crossing rows of teeth.

Single Ended Boiler.—In steam engineering, a boiler fired from one end; as, Scotch boilers with furnaces at one end only.

Single Engine.—A type of locomotive having a single pair of driving wheels only; used for fast passenger traffic.

Single Expansion.—A term applied to an ordinary simple or non-compound engine, in which the whole of the expansion takes place in one stage or cylinder.

Single Fished Joint.—In structural iron work, a fished joint having a single plate or covering strip only, as distinguished from a *double fished joint*.

Single Geared Lathe.—One in which the spindle is attached to or driven directly by the cone, without any intermediate gearing to reduce the speed.

Single Lever Control.—A system of controlling arrangements for a motor car, whereby the important operations of braking and varying the speed are controlled from one lever. Also termed *one lever control*.

Single Lift.—Said of a gasometer, in which the holder proper is not telescopic, being made with a single draw only.

Single Plate Wheel.—A cast iron wheel, having the hub and tire united by only a single plate which is usually strengthened by ribs or corrugations.

Single Purchase.—In rigging, gear for lifting or other purposes in which one pinion and one wheel only, that is a single gear, are engaged.

Single Rail Crane.—A light workshop crane, which runs on a single rail embedded in the floor. It is maintained in a vertical position by means of wheels running on channel iron, hung from or attached to the roof.

Single Riveted Joint.—One put together with a single row of rivets.

Single Riveting.—Single riveting consists of a single row of rivets. Usually all girth seams, those running around the body of the boiler, are single riveted. The size of the rivets should be in proportion to the thickness of the metal of the shell.

Singles.—In manufacturing, silk thread formed on one of the reels from raw silk and twisted. Several singles are united and twisted in a direction contrary to that of the singles, to make *thrown silk*.

Single Shear.—A rivet or bolt is said to be in single shear, when it opposes a shearing force at one point only; as, in an ordinary lap joint.

Single Threaded Screw.—In hardware, a screw consisting of one helix only, winding around the body. Ordinary wood screws are always single threaded, as are also attachment screws and set-screws.

Single Webbed Girder.—In structural iron work, a built up flanged girder whose flanges are connected by a single vertical web only. The term applies both to a plated and to a lattice girder having a single web.

Sink.—1. A box like basin, as in a kitchen, connected with a drain to carry off waste water.

2. In mining, to excavate downward; the opposite of to *rise*; also the depth to which a shaft is to be carried.

3. In plumbing, a trap in the drain of a sink, allowing water to pass and preventing the back flow of gases.

Sinker.—1. In well boring, a long heavy bar, $2\frac{1}{2}$ to 4 inches in diameter, and often 30 feet long, used in a string of drilling tools to give force to the blow; the same as *auger stem*.

2. One of the thin plates, or slips of steel that aid in forming the loops upon the needles in knitting machines.

Sinker Bar.—A heavy bar of round iron which goes to make up the weight in a string of well boring tools. The sinker connects the drill bit with the jars, and is sometimes made in two lengths on account of easy handling; in such a case, the upper half is sometimes known as the *sinker* and the lower part as the *auger stem*.

Sinking.—A mining term, denoting the operation of penetrating downward into the earth, such as in excavating a shaft.

Sinking Head.—In founding, a combination of riser and feeding head in which the whole section of the casting is carried up into the feeding head, to render a sound casting still more sure.

Sinking Pump.—A pump used for clearing the water from foundations, docks, mines, etc. The actual pump consists of two suction barrels whose pistons are worked alternately with a *bob lever*, either by hand or power, the barrels being sunk to the necessary depth below the surface of the water to be pumped, by means of *telescope pipes*. Similar pipes connect the barrels with the suction below. Another form consists of a steam pump self-contained, slung with chains, and so sunk into deep wells and mines for pumping to any required height.

Sinter.—Dross; as, of iron; the scale which flies from iron when hammered.

Siphon.—1. A pipe bent in the form of U or \cap acting on the principle of the hydrostatic balance, so that the pressure of water in one leg always tends to equalize that in the other.

2. A bent tube or pipe with limbs of unequal length for transferring liquids from a barrel or other receptacle. The action of the instrument is due to the difference in weight of the liquid in the two legs.

3. A U shaped tube fitted to steam gauges, etc., so that nothing but water shall enter the gauge.

4. In railways, the curved pipe of gradually increasing section which leads from a water scoop into the tender.

Siphon Gauge.—A gauge formed of a bent or U shaped tube in which the pressure is shown by the difference in level between the fluid in either leg. Siphon gauges with a mercurial column are employed to test or standardize dial gauges, while a siphon with water for its fluid, is the customary instrument for measuring air pressures.

Siphon Pipe.—A bent tube with unequal limbs, by means of which liquids are drawn from a vessel; the shortest limb being placed in the liquid to be drawn off; it is set in action by exhausting the air from the longer.

Siphon Pump.—A device for raising water, similar in principle to the injector. It consists of a steam jet surrounded by a combining tube which is connected to the suction pipe. There are no valves and consequently chips, pieces of grit, etc., may pass, which would choke the valves of an ordinary pump.

Siphon Tank.—An automatic flushing tank for drains, etc., in which a strong

flush is given, by means of a siphon pipe, which begins to operate as soon as the tank has filled to the top of the siphon.

Siren.—An instrument for causing a penetrating sound, capable of being heard great distances, used as a danger signal during foggy weather at sea. Compressed air or steam is blown through a trumpet, at the throat of which is a rapidly revolving disc or cylinder perforated with numerous slits or holes. The sound waves set up by the passage of air or steam, through the revolving perforations, are of remarkable penetrating quality.

Sisal Hemp.—The tough and strong fiber made from a native plant grown in the Bahamas, etc., used largely for making cordage; very useful for ship's cables, as it resists the effects of damp better than hemp.

Siss.—To make a hissing noise; as, an iron hot enough to *siss* when touched with a wet finger.

Site.—A locality or situation; the place whereon any building or collection of buildings has formerly stood, stands, or is intended to stand; the plot of ground where anything is to be built, made or done.

Sits.—In mining, a term used when the roof of a working bulges downward through softness of the strata or lack of shoring.

Six.—The number between five and seven.

Sixfold.—Six times as many or as much.

Sixteenth Bend.—In pipe fitting, a pipe bend which makes an arc of $22\frac{1}{2}$ degrees and which, therefore, connects pipes which diverge at that angle.

Sixty.—The product of six and ten.

Six Wheel Switcher.—A yard or shunting locomotive in which all the wheels are coupled and placed very closely together. To obtain maximum adhesion, leading and trailing trucks are omitted.

Sizable.—Of a considerable volume or bulk; fairly large.

Size.—1. Extent, dimensions, magnitude or bulk of anything.

2. To assort according to dimensions or size of fragments; specifically, in sorting out fine from coarse particles of ore by means of sieves.

3. A glue or gelatinous mass which has been allowed to absorb a great deal of water when boiling, and thus become a soft homogeneous jelly. It is usually made from shreds of leather,

parchment, etc., boiled up together with water and then purified; used by painters, paper makers and others.

4. A variety of glutinous substances used by printers, etc.; specifically, a gummy ink made to retain bronze, gold or silver powders sprinkled over it; a paste or glue wash applied to bindings before gilding; a solution of gum tragacanth used to float the colors in marbling book edges.

Sizer.—1. A machine of perforated plates to sort articles of varying sizes, as the shot and bullet sizer, which has holes to determine the size of the shot and bullets.

2. An adjustable gauge and turning tool used by woodturners, consisting of a sickle shaped part, with a buckle and pinching pin to fasten it on the turning tool. The opening between the gauge point and the point of the tool is first set and the turner proceeds to turn the revolving wood down until the gauge enters.

Sizing.—1. In textile manufactures, to coat the warp fibers with gelatinous composition, for better enabling it to sustain the strains of weaving.

2. In paper making, the deposition on the fibers of a comparatively waterproof substance, principally resin soap treated with alum.

Sizzle.—To make a hissing sound; to dry and shrivel up with a hissing sound.

S Joint.—In sheet metal working, a method of connecting two surfaces, which are at right angles to each other, by means of a doubly bent strip, somewhat like the letter **S** reversed.

Skeet.—In navigation, a scoop used for throwing water on the sails and decks and for other purposes.

Skeg.—The aftermost part of a vessel's keel which supports the rudder post.

Skein.—A knot, or a number of knots of thread, silk, or yarn; a quantity of yarn after it is taken from the reel.

Skeleton Construction.—The modern method of building tall structures on valuable city lots, to avoid wasting too much floor room on thick masonry walls. The building is constructed as a skeleton of steel columns and girders, upon which brick work and terra cotta tiling are hung.

Skeleton Girder.—In structural iron, a girder made by uniting top and bottom angle irons with lattice work or diagonal bracing, the other flanges of the angle irons being attached by riveting to top and bottom plates.

Skeleton Pattern.—An open frame pattern; that is, one which is not precisely like its casting, but whose outlines or bounding edges alone are given. In a skeleton pattern, the central portions are either *strickled* or scraped out, or are *cored* or made up in some other way by the moulder. The reason of their employment is the saving of cost in the pattern making.

Skeleton Spanner.—A thin spanner or wrench made to handle large nuts on the connections of heavy machinery so that the labor of manipulating the proper heavy spanner is avoided until the nut has gripped.

Skelp.—A piece of iron prepared by forging and bending for welding into a pipe. The skelps for gun barrels are drawn out from strips about a foot long, broader at one end than at the other; they are twisted around a mandrel, so as to overlap each other, and then brought to a welding heat, so that the welding up of the twisted barrels is effected at one heat.

Sketch Book.—A bound book of drawing paper wherein sketches, plans, free hand drawings, and notes of details may be drawn in pencil by a draughtsman or engineer.

Sketches.—Preliminary free hand drawings in pencil from which proper drawings are subsequently elaborated. For emergency work or for details, a clear dimensioned sketch is often all that is required.

Skew.—1. Turned or twisted to one side, awry.

2. A skew wheel; an oblique toothed gear wheel.

Skew Arch.—An arch which is not at right angles to its abutments; an archway placed slanting to the road crossing.

Skew Back.—In architecture, the course of masonry forming the abutment for the support of a segmental arch, or, in iron bridges, the support for the ribs.

Skew Back Saw.—In wood working, a hand saw whose back is curved inwards in order to lighten its weight without diminishing its stiffness.

Skew Bevel.—A pair of bevel wheels whose axes are not in the same plane, and thus would not meet each other if prolonged; a bevel drive at an angle greater or less than a right angle. Also called *skew gearing*.

Skew Bridge.—A bridge constructed with a skew arch, or set obliquely to its abutments; a kind of bridge often used where a railroad intersects a stream, canal, or another road, obliquely.

Skew Chisel.—A carpenter's chisel, whose cutting edge is not at right angles to the body of the tool.

Skewer.—1. A pointed piece of wood used to hold pieces of meat together.

2. In spinning, the stem or wire on which a bobbin is mounted in the creel of a spinning frame.

Skew Gearing.—Cog wheels with teeth placed obliquely, so as to slide into each other and avoid clashing. They serve to transmit motion from one shaft to another when the two form an angle, but would not intersect if prolonged.

Skew Point Chisel.—A wood turner's chisel with the nose cranked or offset similarly to a side tool for turning metal.

Skid.—1. A piece of timber placed up and down the side of a vessel, to preserve it from injury by heavy bodies hoisted or lowered against it.

2. A chain used for fastening the wheel of a wagon, to prevent its turning when descending a steep hill.

3. A piece of timber used for supporting anything, or along which something is rolled.

4. To slide; in a railroad car, etc., caused by applying a brake too hard so that the wheels cease to revolve, but slide along the rails, thus greatly diminishing the efficiency of the brake, and tending to wear flat places on the tires.

Skidding.—1. The slipping of a wheel along its rail. A wheel skids through lack of adhesive power or through the brake power being insufficient to overcome the momentum of the moving mass.

2. As applied to automobiles, the occasional tendency of the rear wheels to slide sideways to the direction of travel; as, in taking a curve at too high speed.

Skidding Engine.—In hoisting engines, those engines whose foundation consists of large wooden skids. They are used in construction work where a repeated moving of the engine is required.

Skiff.—A small light boat used chiefly by fishermen on open waters. Such a boat is semi-flat bottomed, having considerable sheer and freeboard. A type similar to the *dory*.

Skill.—The familiar knowledge of any art or science united with readiness or dexterity in its execution or performance.

Skilled Workman.—An expert artisan; one highly skilled in any occupation, art, or science.

Skillful.—Possessed of, or displaying skill; knowing and ready; well versed; able in management; as, a skillful draughtsman.

Skim.—1. To move lightly over the surface of anything, barely touching it.

2. To remove any substance from the upper surface of a liquid, by passing some utensil immediately beneath it.

Skimmer.—1. A device for skimming; a flat ladle or similar utensil for the purpose.

2. An iron bar for holding back the slag in pouring molten metal.

3. In distilling water for ice making, a part of the *reboiler* or a separate vessel provided with a dish or tray, connected with a pipe, by means of which oily matter or scum on the surface of the water is collected and led away.

Skimming Chamber.—In a foundry, a chamber whose use is the separation of the dross or sillage from the metal in a mould. It owes its utility to the principle of centrifugal force, and usually consists of a globular or sometimes of a discoid cavity, placed in the course of the running metal, between the pouring gate and the mould. The metal is run into it on one side and necessarily assumes a whirling motion, which throws the scum to the center, and the heavier iron towards the circumference, where it passes through a gate or sprue into the mould. All work which has to be planed or turned bright all over, is run with a skimming chamber, or as it is sometimes termed, run with a *ball* or run with a *disc*.

Skimming Gate.—In casting, a gate or passage into a mould-contrived so that a whirling motion is given to the fluid metal, so that floating scum and scoræ are retained and do not pass into the mould proper.

Skimp.—A shop term implying to economize severely or unduly; to supply in the least possible quantities; as, oil for lubricating machines.

Skimpings.—In mining, the refuse taken from the upper part of the sieve in jigging.

Skin.—1. In mechanics, the thin film or coating of very hard metal on the outside of a casting or forging, due to the chilling or hardening of the surfaces in contact with the sand of the mould or from contact with the air. In machining, it is necessary to take the first cut deep enough to pierce this skin, while if the piece has to be chipped, the prior use of a chipping chisel or of a grinder is necessary.

2. Planking or plating of a vessel, either inside or out.

Skin Dam.—A dam to exclude water, composed of timber sheet piling with a facing of horizontal waling boards.

Skin Friction.—The resistance to a ship's passage through the water, caused by the friction of her wetted surface or skin: it is dependent upon the nature and area of this wetted skin and the depth of submersion. Properly it is caused by a thin film of water which is carried along by the hull through the other water; roughness of the skin, barnacles, weeds, etc., holding a thicker film and causing greater friction.

Skip.—1. A wicker vessel of any sort, such as a basket.

2. A bucket, now of iron, formerly of wicker work, in which excavated or mined materials are transported.

Skipping Teach.—In sugar making, a dipping vessel which is lowered into the open evaporating pan and filled with saccharine solution through a valve at its bottom. The valve is then closed, the skipping teach raised by a crane and removed to the coolers, where it discharges its contents.

Skip Wheel.—In manufacturing, a wheel in a self stripping carding machine to govern the order in which the *top flats* are lifted to be cleaned. In most cases, the action of the stripper is upon every flat in order, at the next motion taking the alternate flats left on the former passage. In other cases, the action is more frequent upon the flats nearer to the feeding cylinder and which become the soonest choked and inoperative.

Skirt.—In mill stone dress, the margin of the stone outside the furrows.

Skiver.—An inferior quality of leather, made of split sheepskin, tanned by immersion in sumac, and dyed. It is used largely for bookbinding.

Skiving Machine.—A leather worker's machine, used for splitting skins.

Skiving Tool.—In machine shop practice, a tool resembling a turner's knife-tool, used in large boring mills to take a smoothing or finishing cut from an internal surface.

Skylight.—1. In carpentry, a window placed in the roof of a building, or ceiling of a room, for the admission of light from above.

2. In a ship, a hinged window over a vertical opening.

Skysail.—A light air sail carried on clipper ships above the royals.

Slab.—1. An outside piece taken from a log or timber in sawing it into boards, planks, and the like.

2. A thin piece of anything, especially of marble or other stone, having plane surfaces.

3. Tin or lead poured into a stone mould; a flat ingot.

4. In spinning, a thick bat or web of fiber, the result of scutching, teasing and beating.

Slab Frame.—In stone cutting, the frame which holds the saws, cutting marble blocks, etc., into slabs.

Slab Line.—A line or small rope by which seamen haul up the foot of the main sail or fore sail.

Slack.—1. Not tense; not hard drawn; not firmly extended; as, a slack rope; slack rigging.

2. Fine coal; waste or dust coal; culm.

Slack Chain.—In rigging, the loop of chain which hangs below the pulley blocks in lifting tackle, and which diminishes in amount when a load is being lowered.

Slack Fit.—In shop practice, a fit is said to be slack when parts in contact have more freedom of play than is necessary or desirable for their free and easy movement. The term is relative, because what would be a slack fit in some portions of a machine, would be too tight a fit in another. A slack fit in many cases would more properly mean a bad fit, as in the case of the fitting of shafting into wheel bosses, which must necessarily be tighter than the fitting of the same shafting into its bearings.

Slackwater.—The inert state of tidal water, when the tide is neither running in nor out, perceptible at both high and low water, but specially at the latter.

Slag.—A mineral refuse from the smelting of metals, consisting of the flux together with earthy or mineral impurities that may have been in the ores or metal. It is drawn off in a fluid state from the top of the bath of molten metal.

Slag Arch Cooler.—A hollow water cooled framing around the slag notch of a blast furnace.

Slag Brick.—Bricks made from blast furnace slag, either by running it into suitable moulds while fluid, or else granulating it by passing the slag into a shallow pit with running water; the granulated mass is pressed into bricks and dried in the open air.

Slag Car.—In metallurgy, a barrow, bogie or four wheeled car, carrying a ladle, in which slag is removed from a furnace to the tip or dump.

Slag Furnace.—In smelting, a furnace for extracting lead from slags or from poor ores.

Slag Notch.—The opening in the crucible wall of a blast furnace through which the slag is tapped or drawn off. Also called *slag hole*.

Slag Pit.—In smelting, a depression made beneath the tap hole of a steel melting furnace to receive the slag after the metal has been *tapped out*.

Slag Wool.—On blowing a jet of steam at about 50 lbs. pressure through fluid slag as it issues from a furnace, the slag is blown into fine fibers resembling asbestos or spun glass; from its appearance, the material thus formed is termed *slag wool*, also *silicate cotton* or *mineral wool*, and being non-combustible and non-conducting, is used as a covering for steam pipes, engine cylinders, etc.

Slake.—To quench or allay; to abate or render less strong and active by absorbing or receiving something. The term is always connected with water; as, to *slake lime*, by pouring water on it. Also spelled *slack*.

Slaked Lime.—In masonry, lime which has undergone a chemical combination with water, thus losing solidity and cohesion.

Slake Ladle.—A ladle, or cup-like handled implement, used by blacksmiths to wet the coals in their forges.

Slam.—To strike with force and noise; to shut with violence; as, to *slam a door*; a puppet valve *slams*.

Slant.—Inclined from a direct line, whether horizontal or perpendicular; sloping; oblique; as the slope or angle of a roof.

Slant Height.—The linear measurement of a cone or pyramid from apex to base, taken along one of its sides, as differentiated from vertical height, which is the perpendicular distance from the apex to a point in the base line.

Slantwise.—In an inclined direction; obliquely.

Slap Dash.—In a bold careless manner, like a painter putting color on hastily and irregularly with a large brush.

Slash Bar.—A fire tool; a long heavy poker used for breaking lumps of fuel in a furnace.

Slasher.—In cotton manufacture, a sizing machine.

Slat.—A narrow piece of board or timber used to fasten together larger pieces; as, a flat step or rung of a ladder.

Slat Conveyor.—The same as an *apron conveyor*; one made of transverse wooden or metallic slats mounted on a traveling belt, thus constituting an endless traveling platform for handling grain, ore, etc.

Slate.—1. A stone which readily splits into plates.

2. Any rock or stone having a slaty structure.

3. A prepared piece of such stone; as, a thin and flat piece for roofing.

Slate Axe.—A slate cutter's hammer with a pointed head.

Slate Pencil.—These useful articles are made in different ways: (1) By sawing and cutting strips from slate, which are afterwards rounded to form; (2) by grinding up slate waste into powder of uniform fineness which is mixed with a suitable binding material, and compressed by hydraulic machines into the correct form; (3) by splitting *soapstone* in plates, which are sawed into strips and then rounded to cylindrical form.

Slate Roofing.—Slate, split and sawed into uniform rectangular slabs, about $\frac{3}{16}$ inch thick, and secured by means of nails to battens on a roof. The battens are generally overlaid with felt or waterproof paper board. The common size for a $\frac{1}{2}$ pitch roof is that known as Countess slates (20x10 ins.), the laps being usually 3 inches over the nail holes, which are generally drilled in the center, galvanized iron, or brass composition nails being employed. If the nails are at the top or *head* of the slate, its *tail* must overlap the nail holes of the second slate below, thus giving in either case a *margin* or visible depth of $\frac{3}{4}$ ins. for each course.

Slating Battens.—In building, deal strips about $\frac{1}{2}$ inch thick, fastened to rafters twelve to eighteen inches apart. The slates are nailed, in turn, to the battens.

Slat Matting.—A floor covering consisting of narrow wooden *slats* attached to a flexible fabric, such as by gluing on to cloth, so that the whole may be rolled up as a carpet.

Sleazy.—Thin or flimsy, wanting substance. Said of textile fabrics.

Sled.—1. A heavy vehicle mounted upon runners instead of wheels for transport over snow or heavy land. Also known as *sledge*.

2. A light contrivance of similar form for purposes of winter amusement.

Sledge Hammer.—A heavy hammer wielded with both hands. That used by the blacksmith's helper is usually *cross* *pened*, and weighs from 5 to 14 pounds. The sledge used by a machinist or erector is usually double faced, as he uses it for driving work only. For light blows, the hammer man uses the sledge "*up hand*," for powerful blows it is wielded "*about sledge*."

Sleeker.—A moulder's hand tool used to dress and finish the mould, smoothing irregularities and removing detached portions of the sand that may have broken away. Many forms are in use known as square, heart, leaf, bead, flute, spoon, taper, flange, corner, etc. Also written *slicker*.

Sleeper.—1. In carpentry, one of the set of timbers supporting the lower floor of a building. The timbers of the upper floors are *joists*. The sleepers in a wooden frame rest on the sills; in a brick or stone house they rest in the walls.

2. One of the timbers supporting a railway track. When it is longitudinal with the track, it is called a *stringer* or *sill*; when it is transverse it is called a *cross sleeper* or *tie*.

Sleeping Car.—A railway car fitted with sleeping berths. There are two tiers of berths arranged longitudinally, screened off by curtains; the upper berth is hinged, permitting it to be folded up when not in use, and the lower one is convertible into seats.

Sleet.—Hail or snow, mingled with rain, usually falling, or driven by the wind, in fine particles.

Sleeve.—A tube into which a rod, or another tube is inserted; a tube encircling a rod or another tube; if small it is often called a *thimble*. If serving to merely strengthen the object which it encloses, it is a *reinforce*.

Sleeve Coupling.—1. A cylindrical piece bored to fit two lengths of shafting which it serves to unite, one length being keyed into either end.

2. A screwed pipe socket or socket coupling which joins lengths of screwed pipe together.

3. A cylindrical piece, forming two pipe bells placed back to back, used to connect the male ends of two cast iron pipes, where necessary.

Sleigh.—A vehicle moved on runners, and used for transporting persons or goods on snow or ice. Also called *sled*.

Slew.—To swing or swerve at an angle to the proper course; to slide sideways going around a curve, with a *motor car*; to move around to an angle with its original position; as, with a vessel.

Slewing.—In railway construction, etc., the lateral displacement of a track, by the aid of crowbars and the like. Frequently practiced in the operation of construction lines or during track repairs.

Slewing Gear.—An arrangement of parts for effecting a *slewing* motion in a crane, derrick, etc.; that is, swinging the jib from side to side on its pivot, so that it is brought fair with the hoist or the place of deposit. In hydraulic cranes, a pair of opposed cylinders, one on either side of the pivot, are employed to slew the jib through the required arc, thus obviating the use of guys, and accurate centering is assured by means of regulable stops on the valve gear.

Sley.—1. A weaver's reed.

2. To separate; to part the threads of, and arrange them in a reed; a term used by weavers.

Slice.—1. A long chisel-like bar for stripping off a vessel's planking or sheathing.

2. A steam shovel.

Slice Bar.—A thin, wide, iron tool, seven or eight feet long, for cleaning clinkers from the grate bars of a fire. The lower side of the slice bar should be flat so that it may slide on the surface of the grate bars, as it is forced beneath the fire; the upper portion of the edge should be in the shape of a half wedge, so as to crowd upwards the ashes and clinkers while the lower portion slides along.

Slick.—1. To smoothen, as the surface of a founders' mould, or leather, with a slicker.

2. In founding, a slicker.

Slicken Sides.—In mining, polished and grooved surfaces of rock caused by the motion, under immense pressure, of the country rock or the lode itself.

Slide.—1. To cause to pass along over a supporting surface by a smooth, slippery movement; as, to *slide* timber down a hill.

2. In a steam engine, that part of a cross-head or other reciprocating piece, which bears on a guide; also a *guide bar*.

3. In mining, an almost parallel fissure, either empty or filled with flucan that crosses the lode and heaves it slightly out of position.

Slide Bars.—In a steam engine, the bars which serve as a guide for the piston rod crosshead; the guide bars.

Slide Rest.—A lathe tool rest designed to travel automatically along the bed of the machine, feeding the tool to the work for turning or screw cutting. It consists of a saddle or carriage fitted to the shears or edges of the bed, and has usually two slides, one for sliding, the other for surfacing. A circular swiveling motion is also provided so that turning may be effected at an angle with the lathe centers. The two smaller slides are usually operated by hand screws, while the cross feed, or surfacing motion and the traverse are effected either by hand or power with rack and pinion movement, or through a leading screw.

Slide Rule.—A rule much used by draftsmen, having a sliding part graduated with logarithmic numbers, these being so arranged relatively to other similar graduations on the body of the rule that, when a chosen number on the slide is placed in correspondence with a certain number on the rule, a product or fraction is obtained without calculation.

Slide Valve.—In a steam engine, a cup shaped piece of metal arranged to slide over and alternately cover and uncover the openings or ports through which steam is distributed to the cylinder; called also, *D valve* and *D slide*. It is situated in the steam chest, and is moved by the valve gear.

Slideway.—A lengthwise bearing, keyway or groove, within which another part may slide to and fro.

Sliding Contact.—The contact which exists between two flat surfaces moved over each other, as differentiated from *rolling contact* in which one part rotates on the other.

Sliding Fit.—In machinery, when surfaces, cylindrical or plane, move, one over the other freely, yet without perceptible slackness, the fit is so designated.

Sliding Friction.—In mechanics, the friction existing between two bodies in sliding contact with each other.

Sliding Gear.—The change speed gear of an automobile when arranged on the clash gear system.

Sliding Gunter.—In navigation, a mast with means for mounting on the after side, used with royals, skysails, etc.

Slimes.—In mining, the fine sands of pulverized ore carried away by water from the coffers of the stamps.

Sling.—1. An endless rope, by means of which objects are securely held while being raised or lowered, as with a crane or pulley block. Chains are frequently used for heavy lifts, having an eye at one end and a hook in the other, by which the sling is secured.

2. The chain, clamp, or rope which secures a yard to the mast.

Sling Chain.—In rigging, an ordinary piece or a *bight* of chain, used for encircling heavy work for the purpose of lifting it about, the crane hook being inserted into a lap of the chain.

Sling Dog.—One of a pair of hooks used at the end of slings, for hoisting or hauling.

Slinging.—In rigging, the securing of heavy masses of material, in the ropes or chains of cranes or of pulley blocks, while being hoisted about. The methods of slinging vary with the shape of the body which is being lifted.

Slinging Wires.—Wire hooks, etc., upon which articles are slung within an electroplater's baths.

Sling Scaffold.—In erecting, a suspended scaffolding. Projecting beams are fixed at the level above which the work is to be executed, and by means of pulley blocks fixed to these, the scaffold may be raised or lowered to any desired height. Also called a *boat*.

Sling Stay.—In a locomotive type of steam boiler, a rod or stay from the outer shell to the crown sheet; the row or rows of crown stays next the tube plate are sling stays, that is, made with knuckle joints or double eyes to give a certain amount of flexibility and permit the tube plate to adjust itself to changes of temperature.

Sling Stay Boiler.—In steam engineering, a boiler provided with stays at each end, with a pin fitting through a hole in a tee or channel bracket on the boiler plates, and a corresponding hole in the end of the stay. It gives some degree of flexibility and allows the plates to contract and expand freely and independently.

Slip.—In hydraulics, that amount by which a mechanism falls short of its

theoretical performance, with regard to something to which it is not rigidly connected, generally expressed as a percentage of the theoretical amount; as, the *slip* of a screw propeller, or of a water pump.

Slip.—In coal mining, a skip or sledge without wheels.

Slip Joint.—An inserted brazed or soldered joint, in which the end of one piece of pipe is slipped into the flared or swaged end of the other.

Slip Knot.—A knot permitting the standing part or bight of the rope to pass through it, thus constituting a running noose.

Slip of Propeller.—In a steamship, the difference between the distance traveled by the propeller, obtained by multiplying together the pitch and the revolutions during a stated period, and the distance traversed by the ship. It is expressed as a percentage of the former; if the engines travel faster than the ship, it is *positive slip*; should the ship, through currents, etc., outrun her propeller, it is known as *negative slip*. With certain bluff lined vessels having slow moving propellers, the latter frequently occurs without being due to current.

Slippage.—More generally *slip*. In hydraulics, the difference between the calculated and actual work performed by a pump, expressed as a percentage of the former.

Slipper Out.—The windlass or reel mounted upon the walking beam of a Canadian drilling rig, which pays out the chain a link or two at a time, as required, to feed the tools into the ground, or by means of which the whole may be wound in to start a fresh run. The *slipping out* is effected by means of a ratchet wheel and pawl.

Slippery.—Having the quality opposite to adhesiveness, allowing or causing anything to slip or move smoothly, rapidly and easily upon the surface.

Slippery Iron.—In metals, a mixture of cast iron specially prepared for engine cylinders, cylinder liners, slide blocks and moving surfaces. It is tough and moderately hard, and its smoothness of surface is obtained by using a brand of iron where manganese is present to the amount of two or three per cent.

Slip Rope.—In a vessel, a rope by which a cable is secured, preparatory to slipping the cable.

Slip Shackle.—One whose pin or bolt is fitted with a trigger or lever, so that it may be suddenly withdrawn.

Slipway.—An inclined railway, up which ships are drawn on cradles or cars, on which they have previously floated. A quick way of inspecting and painting small craft.

Slit.—In coal mining, a short heading connecting two others.

Slitters.—In paper machinery, revolving cutters which divide the web into portions of suitable width, the sheets being afterwards cut off to the right length by means of stop or continuous cutters.

Slitting File.—A file of flattened lozenge shaped section, having two thin knife edges.

Slitting Mill.—A mill where iron bars or plates are cut or slit into narrow strips; as, nail rods, and the like.

Slitting Roller.—One of a pair of heavy rollers, furnished with alternate ribs entering between each other, and cutting the metal plates in the manner of shears, used in slitting mills for metals, etc.

Sliver.—1. In spinning, a loose, spongy aggregate of fibers, made by drawing the *fleece*, delivered by the carding machines, through funnels and rollers. The term is properly applied to the yarn in its early stages of manufacture.

2. A sharp, slender fragment; as, of wood; a splinter; a long piece cut or rent off.

Sliver Box.—In worsted manufacture, a machine for piecing together and stretching the slivers of long stapled wool; also termed *breaking frame*.

Sloat.—A narrow piece of timber which holds together large pieces; a slat.

Sloop.—A vessel having one mast and a fore and aft rig. The sloop usually carries a centerboard and depends for stability upon breadth of beam.

Slop.—To overflow or be spilled, as a liquid, by the motion of the vessel containing it; often followed by over; as, slop over.

Slope.—1. An oblique direction; a line or direction inclining from a horizontal line; properly, a direction downward.

2. A declivity; any ground whose surface forms an angle with the plane of the horizon; also, an acclivity, as every *declivity* must also be an *acclivity*.

Slope Hoist.—In coal mining, an inclined shaft, wherein the cars are hauled on rails instead of being hoisted in cages. When worked by a self acting plant, it is said to be "from the rise," when worked by steam or other power, to be "from the deep." In metal mines, such passages midway between a shaft and an adit, are known as *inclines*.

Sloping Surface.—A surface which is neither vertical nor horizontal, but inclined at an angle.

Slot.—In machine shop practice, a depression or mortise in a plate of metal, or a slit or aperture through it, for the reception of some part of a machine, either fixed, as a key bolt, or movable, as a sliding adjustment.

Slot File.—A thin narrow parallel file used to dress out cotter holes or slots; known to the trade as a *pillar file*.

Slot Link.—In a steam engine, a reversing quadrant or link having the link block working in a curved slot; much used for small marine engines and locomotives.

Slotted Holder.—A drill holder which is slotted for the reception of the shank of a flat drill or packed bit.

Slotting.—1. The vertical cutting of grooves and keyways; also the shaping of curved outlines by means of a slotting machine.

2. Movement within a slot.

3. Forming or finishing rectangular holes in metal by the aid of broaches or drifts; these are square punches or drifts with serrated edges, which cut away the metal as they are driven through.

Slotting Auger.—A woodworking tool which bores a hole and then cuts it laterally into a slot, the work being fed against chisel shaped cutting edges on the sides of the bit.

Slotting Machine.—A machine tool for making mortises and the like; a modification of the shaping machine.

Slotting Motion.—In a locomotive, a term applied to the vibratory movement or slip of the link block in the quadrant, it may be greatly lessened by careful choice of the point of suspension for the link.

Slow.—1. Moving at a moderate speed; the opposite of *fast*.

2. Not prompt or quick in action, tardy in operation.

3. Belated; behind time.

Slow Burning Construction.—A type or class of construction suitable for mill buildings, in which heavy hardwood timbers are employed, fitting closely into each other, without crivices for the accumulation of dust, for the passage of air or for affording play to the flames of a fire. Experience has shown that such structures, while being far cheaper than fireproof buildings, resist the flames so much that little more than a superficial charring is likely to occur with ordinary fires.

Slow Feed.—In shop practice, when provision is made for two sets of feed motions, as in many drilling machines, one is termed the *slow*, and the other the *fast* or *quick* feed, the variation being necessary, since different work demands different rates of feed according to the coarseness or fineness of the finish required, or the nature of the metal itself.

Slow Match.—A slow burning fuse made by boiling slightly twisted hempen cord in a solution of saltpeter. It will burn at the rate of one yard in eight hours.

Slow Setting.—A term applied to mortars and cements, denoting that they harden gradually; this is frequently an advantage, and it may be taken as a general principle, other things being equal, that the slower a cement sets, the firmer it will ultimately be.

Sloyd Knife.—A knife used for wood-carving in conjunction with the Sloyd system of hand and eye training; it has a blade like a stout jack or pocket knife set rigidly in a substantial wooden handle.

Slub.—1. In woolen manufacture, a roll of wool slightly twisted; a term corresponding to rove and *roving* in the manufacture of cotton; called also *slubbing*.

2. To draw out and slightly twist.

Slubber.—To daub; to stain; to cover carelessly. Also a slubbing machine, a textile appliance to draw out *slubs* or coarse hanks of wool into twisted portions.

Sludge.—1. In steam engineering, the muddy deposit which accumulates in a steam boiler.

2. In mining, the mud formed at the bottom of the drill hole, from the cuttings and water. When dug it is known as *boremeal*.

Sludge Cock.—In steam engineering, the cock at the bottom of a steam boiler which is employed for the purpose of cleaning the boiler from sludge by periodical *washing through* by a strong current of water. Also called *blow off valve*.

Sludge Press.—An apparatus for removing as much liquid as possible from the sludge recovered from the receptacles of a sewage system, the object being to remove as little weight of water as possible when finally depositing the sludge out at sea or elsewhere.

Sludge Tanks.—In sewage, receptacles arranged for the solid precipitant or sludge which remains after the sewage has been chemically or bacterially treated.

Sluggish.—A shop term, indicating one habitually idle and lazy; slothful; dull; inactive.

Sluice.—1. In hydraulics, an artificial passage for water, fitted with a sliding valve or gate, as in a mill stream, for stopping or regulating the flow.

2. Any opening; that from which anything flows; a source of supply.

Sluice Box.—In gold washing, a trough made of boards, through which the gold bearing gravel is carried by a current of water. Longitudinal and transverse *riffles*, the latter having grooves filled with mercury, serve to retain the gold. Sluices are built up of several boxes, and generally made in pairs, so that one can be "cleaned up" while the other is working.

Sluice Gate.—In hydraulic engineering, a sliding plate which covers the opening of a sluice, as in a dam, dock wall or lock gate. The gates or doors move in vertical channels and are actuated by a rack and pinion, or else by means of a long screw passing through a nut in the gate.

Sluice Valve.—In hydraulics, a fullway valve, having a straight bore with two inclined seats at the central extremity of either passage. The valve proper, of wedge shaped section with two circular faces, fits between the two seats, when the valve is shut; when it is opened, the valve is drawn clear up into a central chamber, leaving an opening the full bore of the passages. Also called a *gate valve*.

Slump.—A shop term, indicating to fall or sink suddenly through or in; as, the wall *slumped* on account of the frosts.

Slurry.—1. Clay or similar earthy material mixed with sufficient water to be liquid, so that it can be transported along a pipe or flume as a fluid.

2. Any liquid, black wash or water used about a foundry.

Slurry Pump.—One specially adapted for dealing with thick liquids, such as slurry, etc. A pulsometer, a valveless pump, or one with mechanically moved valves is usually employed in moving the heavy liquids.

Slush.—1. A soft mixture of grease, and other materials used for lubrication.

2. Soft mud; sludge; slosh.

Smack.—1. A shop term, for a quick sharp blow.

2. Taste or flavor; tincture; especially a slight taste or flavor.

Smalt.—A pigment of various shades of blue and green prepared by making a glass with cobalt ore, potash and calcined quartz. The glass is ground to a fine powder to form smalts, which are used for decorating pottery or for frescoes.

Smashing Machine.—A sort of embossing press, used by bookbinders for compressing books.

Smear.—In mechanics, to overspread with anything; as, with fat, or other oily substances; as, to *smear* the sides of a ferry slip, so that a vessel can more easily glide into its moorings unimpeded by friction.

Smearing.—In pottery, the firing of earthenware so that a luster is obtained without glazing. A saline flux within the *saggars* evaporates and is condensed upon the ware.

Smeaton, John.—Born 1724, died 1792. An English civil engineer. He invented an instrument for measuring a ship's progress (1751); made important improvements in hydraulic machinery; built the third Eddystone Lighthouse (1756-59), which was a marvel of intricate dovetailed stone construction; constructed arched masonry bridges, canals, harbors and many other important public works.

Smell.—One of the five senses; odor; scent.

Smell Chamber.—In paper making, a division of the soda regenerating plant, in which the strongly smelling gases, from the liquor under concentration, are passed through masonry at a red heat, to deodorize them.

Smelt.—To treat ores, on a large scale, in furnaces or by heat, so as to remove impurities and extract the metals. The operations vary with different ores from simple continuous operations, as with galena, to highly complicated processes in successive furnaces as with copper ores. The general series of smelting operations is: (1) calcination or roasting to get rid of sulphur, etc., as far as possible; (2) reduction of the oxides so obtained, to form the *matte*, impurities running off as slag; (3) refining the *matte*, eliminating the foreign metals so that the pure metal remains.

Smelter.—A smelting works. Usually applied to a plant for the smelting of silver, copper, lead, etc. Iron smelting works are termed *blast furnaces*, and those where precious metals are extracted by amalgamation, chlorination, etc., are known as *reduction works*.

Smelting.—Separating metals from their ores by the heat of a furnace, accompanied by chemical action. To facilitate the latter, various *fluxes* are required and sometimes reducing agents.

Swift.—In mining, a match of paper saturated with niter or other combustible substance for igniting a charge of powder.

Smith.—One who smites, or works on metal with a hammer, such as a *goldsmith*, *tin-smith*, *housesmith*, etc. Without other qualification, the name denotes a *blacksmith*, who forges articles from wrought iron and steel, forming the heated plastic metal into the desired shape, by blows with and upon suitable tools, which reduce or draw it down to the desired shape or size.

Smithcraft.—The art or occupation of a smith; smithing.

Smith's Brace.—In blacksmithing, a hand brace used by smiths for drilling holes of moderate diameter. Its outline is very similar to that of the ordinary carpenters' brace, and it is turned in the same way, but the requisite pressure is imparted at the top, by means of a feeding screw, against whose end the top of the brace, which is formed into a hardened point, is centered. The resistance is taken by a horizontal arm, having a boss tapped to receive the feeding screw, the arm being capable of sliding up and down, and of being tightened at any height on a vertical pillar, whose foot is bolted to a bench or clasped in a vise.

Smith's Hammer.—In blacksmithing, smith's hammers embrace the *sledge hammer*, the ordinary *hand hammer*, having either a straight or a ball pene at the small end, the *set hammer* and the various *flatters* and *fullers*, which though not strictly speaking hammers are nevertheless tools of a similar type.

Smith's Shop.—In blacksmithing, the shed or building in which the operations of a smith's work are carried on. The forges are arranged around the walls, space being left between each for the racks which carry the *swages*, *fullers*, *chisels*, and other similar tools; the *anvil stand* is in front of these open spaces. A light wall crane is attached to the wall between each forge or one to two forges. The central open space of the shop is occupied with steam hammers, forging machines, etc. A shed adjoining the shop is used as a store for bar iron.

Smith's Tools.—In blacksmithing, these include *anvils*, *anvil stands*, *forges* and *firing tools*, *hammers*, *tongs*, *flatters*, *fullers*, *swages* in their various forms; *sets*, *pliers*, *punches*, *bolt and heading tools*, and *drills*, *chisels*, *saws*, and *machines*, both special and those common to the fitting and erecting shops.

Smithy.—The workshop of a blacksmith. In an iron works, it is the smith's shop for medium and small work, large and heavy operations with steam hammers or hydraulic presses being carried on at the *forge*.

Smock Mill.—A wind mill in which only the cap turns round to meet the wind, in distinction to a *post mill*, whose whole building turns on a post.

Smoke.—In mechanics, the visible vapor, or substance that escapes or is expelled from a burning body; applied especially to the volatile matter expelled from wood, coal, peat, and the like.

Smoke Arch.—In steam engineering, the smoke box located at the rear of a boiler setting.

Smoke Black.—In mechanics, a term meaning the same as *lamp black*.

Smoke Box.—A chamber into which the tubes of a boiler deliver the heated gases and products of combustion, whence they are taken away by the chimney. In a locomotive it is usually a cylindrical prolongation of the boiler barrel, resting upon the saddle formed by the cylinder castings; also called *smoke arch*.

Smoke Box Netting.—In a locomotive, a woven network of wire placed in the smoke box of a locomotive to serve as a spark arrester. The modern practice is to use this netting, which necessitates an extension of the length of the smoke box, to get sufficient area through the meshes. Formerly elaborate arrangements of petticoat pipes or a diamond stack were considered necessary.

Smoke Breaching.—In boiler setting, the passage formed of sheet iron to convey the products of combustion from the boiler to the chimney; smoke bonnet.

Smoke Burner.—A furnace in which the object of the device is to so apply the fuel that the escaping combustible matters shall be exposed to incandescent fuel and due supply of vital air, which conjunction of agents will consume the combustible gases and the particles of carbon suspended therein. Also called *smoke consumer*.

Smoke Prevention.—In the combustion of fuels, a method whereby the smoke, which consists of finely divided particles of unconsumed carbon or pellicles of carbon containing hydrocarbon gases, may be exposed to the incandescent fuel together with a proper supply of air.

Smoke Stack.—A funnel or chimney; an upright pipe, usually of sheet or plate iron, or steel, through which the products of combustion, as smoke and gases, are passed: a chimney of a locomotive.

Smoke Stack Cone.—In a locomotive, an inverted cone of cast iron placed over the barrel of the chimney, in a diamond stack, to deflect large sparks, which may be thrown out, into the *cinder pocket*.

Smoke Stack Lift Pipe.—A prolongation of the smoke stack into the interior of the smoke box, close down to the blast nozzle, where there are no petticoat pipes fitted.

Smoke Test.—In plumbing, the tightness of the drainage system of a building is tested by forcing smoke from oily waste, burned in a special apparatus, into an open portion of the piping. Leaky joints, etc., may then be detected by smoke oozing through them, or by the acrid smell penetrating to the rooms.

Smolder.—To burn and smoke in a smothered way; to burn slowly underneath while showing little smoke and no flame; said of fire, fuel, embers, and the like.

Smooth.—1. Having a uniform surface, devoid of roughness; presenting no irregularities to the eye or touch.

2. Possessing a surface or texture relatively devoid of roughness, harshness or irregularity.

3. To reduce to a uniform plane surface.

Smooth Cut.—A finely cut file, used for finishing surfaces which have to be polished; an ordinary 12 inch file of this cut, will have about 70 or 72 teeth to each inch of length.

Smooth Cut File.—In file making, an ordinary smooth or fine file. A smooth cut file of 12 inch length will contain 72 lines of teeth to the linear inch.

Smoothing Plane.—A small plane used by woodworkers where smoothness is required, but a perfectly accurate or level is unnecessary. It is generally 7 to 9 inches long, with an iron varying in width from 1½ to 2½ inches.

Smoothing Stone.—A block of soapstone used as a substitute for a flat iron. It is cut to much the same shape and has a handle of metal.

Smudge.—1. A suffocating smoke.

2. A heap of damp combustibles partially ignited and burning slowly, placed on the windward side of a house, or the like, in order, by the thick smoke, to keep off insects.

Smutch.—To blacken with smoke, soot or coal. Also written *smooch*.

Smut Machine.—In flour milling, a machine for removing the smut or fungus from grain, at the same time polishing the berry by removal of the beard at the opposite end to the germ, and brushing off the dirt. These operations are effected by means of revolving screens, perforated cylinders, and the like, assisted by mechanical brushes and a fan blast.

Snack.—1. A slight, hasty repast.

2. To share; as, *to go snacks*. These are shop meanings, of widely extended use.

Snag Boat.—On the western rivers, a steamboat fitted with special appliances for removing *snags* or logs that are imbedded in the mud of the river, and which constitute a serious obstruction to navigation.

Snail.—A peculiarly shaped cam, used where an abrupt drop movement is required in certain machinery, so called from its resemblance to a snail shell.

Snakestone.—A kind of hone slate or whetstone obtained in Scotland.

Snape.—A shipbuilding term, denoting the operation of beveling the end of a

piece of timber so as to make it fit upon another piece which it meets obliquely.

Snap Flask.—In moulding, a collapsible flask or casting box, which is hinged together by the corners, and fastens into its square shape with a latch. Used for convenience in transport and stowage.

Snap Head.—A hemispherical or rounded head to a rivet or bolt; also, a swaging tool with a cavity in its face for forming such a rounded head.

Snap Head Rivet.—In structural iron work, a rivet whose head is semi-circular or cup shaped in section.

Snap Hook.—A hook shutting with a catch or snap.

Snappish.—A shop term applied to one apt to speak angrily or testily; one easily provoked and sharp in reply.

Snarl.—To emboss or flute; as, in hollow metal work.

Snarler.—1. One who snarls; a grumbling, quarrelsome fellow.

2. One who makes use of a snarling iron.

Snarling Iron.—1. A tool with a long beak, used in the process of snarling. When one end is held in a vise, and the shank struck with a hammer, the rebound of the other end or beak, gives the requisite blow for producing raised work.

2. A stake with its beak turned at an angle generally of 90° and suitably pointed. It is used for embossing or fluting; as in repoussé work.

Snatch.—A hasty catching or seizing; a grab; a catching at, or attempt to seize suddenly.

Snatch Block.—A wooden or iron block with half of one cheek working on a hinge, to enable ropes to be put in or taken out without unreeving; one having an opening on one side to receive the *bight* of a rope.

Sneak Box.—A small shallow boat with little freeboard and masked by weeds or brush; used by hunters to approach wild fowl unobserved. Also called *sneak boat* and *duck boat*.

Snecked Rubble.—Irregular or random coursed rubble masonry, built up of squared rubble, without attention to regular courses; known also as *broken ashlar*.

Snecks.—Small squared stones used in rubble masonry to square up or make level, irregular courses.

Snifting Valve.—1. In a condensing steam engine, a back pressure valve on the exhaust, opening to the atmosphere to relieve any excess pressure should the condenser flood.

2. On a locomotive, a relief valve fitted to the steam chest and constructed so as to admit air when the engine is running with closed throttle. This prevents the suction, created by the moving piston, drawing in air and cinders through the exhaust nozzle.

Snips.—Small, stout, short lipped shears used especially for cutting metal.

Snore Hole.—In mining, a suction hole in the *snore piece* of a deep pit pump; so called from the noise the pump makes at intervals.

Snout.—A nozzle, more especially of a steam fire engine hose.

Snow.—Watery particles congealed into white or transparent crystals or flakes in the air and falling on the earth.

Snow Plow.—A machine for clearing a railroad track of snow. It consists of a car or locomotive fitted with a wedged prow which is rushed at the drift to force an opening. One type of plow has a rotary cutter which scoops up the snow and throws it to one side of the track.

Snub.—In mechanics, to check; as, a cable or other rope suddenly when running out; also a *snubbing post*, as placed on docks.

Snub Cube.—A solid with thirty-eight faces, of which 6 are squares and thirty-two triangles.

Snub Post.—In navigation, a post on the dock, or shore, around which a rope is thrown to check the motion of a vessel.

Snucks.—A shop term used to denote equal shares. Also *snacks*.

Snug.—A small rib or lug on a shaft to drive a wheel or sheave on it; the interlocking part of a striking clutch.

Snying.—In shipbuilding, a curved plank worked *edgewise* into the bows.

So.—In like manner or degree; in the same way; a word used to denote comparison or resemblance.

Soak.—In mechanics, to cause or suffer to lie in a fluid till the substance has become thoroughly saturated; to steep; to macerate in water or other fluid.

Soaking Pits.—A set of fire brick moulds or vaults beneath the floor of a rolling mill, kept covered to exclude the air. As soon as a steel ingot is stripped from the iron mould, it is placed in the soaking pit, where the internal heat anneals the outside of the ingot, which has been to some extent chilled in casting, relieving any strain set up by the process. After once heating, the pits are kept red hot by the fresh ingots and thus the necessity of reheating, at least before *cogging*, is obviated.

Soap.—This is, popularly, a substance soluble in water, capable of forming a lather and possessing cleansing properties. Chemically, it is a salt, the combination of an alkaline metallic oxide with an acid radical from a fatty acid; such as, oleic, stearic or palmitic acid, the glycerine from the fat or oil being set free in the process. For instance, common yellow or *hard soap* is made by boiling olive or coconut oil, suet, etc., with caustic soda, forming *sodium oleate* and glycerine. The subsequent addition of dry common salt makes the soap rise in a curdled state, it being insoluble in the salt solution; the glycerine and lye are run off, and the soap is reboiled in lye too strong to dissolve it, the sub-lye being again run off. The soap is then ladled into frames or *asses* where it sets. *Soft soap* is made by boiling olive oil with caustic potash, resulting in *potassium oleate* and glycerine; to add salt would make this a soda soap, so the whole is evaporated to a soft consistency, the glycerine remaining. The better soaps are *milled*; that is, cut into shavings, the perfume or drug incorporated therewith, and then moulded under pressure into bars or cakes. Rosin and other fillings are frequently added, but they are really only adulterants. The incorporation of extra glycerine at low temperatures is frequent with good toilet soaps.

Soap Boiler.—1. One who manufactures soap.

2. The vessel or kettle in which the ingredients are boiled together in order to form soap.

Soapstone.—A soft magnesian mineral, usually gray, white or yellow, easily wrought with tools and used in forming vessels and various articles; so called from its soapy or greasy feel.

Soapstone Gasket.—In pipe fitting, a form of packing used for hydraulic joints, made of hemp, tallow, French chalk and other ingredients. Called *soapstone* because of its greasy nature.

Soapsuds.—Water impregnated with soap, especially when worked up into bubbles and froth.

Soap Water Can.—In machine shops, a cylindrical tin can, open at the top and

furnished with a stop cock near the bottom. It is used to effect the lubrication of work which is being turned or otherwise machined, the stop cock being opened only just so much as will allow of the slow drip of the fluid contained in the can, upon the work. The usual lubricant is soap and water, or oil.

Soapy Water.—A shop term for a lubricant used in cutting wrought iron or mild steel. It cools the point of the tool and lessens friction between it and the chip of metal which it is taking off.

Socket.—1. A recess, or a piece furnished with a recess, into which some other piece may be inserted and securely held; as, a socket in the ground for the reception of a post or pole.

2. A socket or sleeve coupling.

3. The enlarged and recessed end of a cast iron pipe, into which the opposite end of another pipe is inserted; the pipes are turned and bored, jointed with a rust joint and lead caulked in.

Socket Bolt.—A bolt passing through a thimble that is placed between the parts required to be connected by the bolt.

Socket Chisel.—A strong chisel used by carpenters for mortising, the handle fitting into a socket forged on the blade.

Socket Coupling.—A cylindrical sleeve, provided with a tapering internal thread at either end, for connecting two lengths of pipe to each other. Also called *sleeve coupling*.

Socket Joint.—A means of connecting pipe together, where a collar or socket of larger size, having an internal or female thread, is screwed on the end of the one pipe, and the next length is screwed into it, thus making a heavy and substantial joint.

Socket Pipe.—In pipe fitting, a cast iron pipe which is provided with a socket at one end and a *spigot* at the other. The sockets of wrought iron pipes are unions, and are screwed over the ends on the outside diameter.

Socket Plug.—In steam fitting, a plug for stopping the ends of pipes or openings in pipe fittings. It differs from the ordinary plug, in that it is provided with a recess or *socket* into which the spanner fits instead of an internal projection.

Socket Pole.—A pole armed with an iron socket and used to propel boats, etc.

Socket Wrench.—In mechanics, a spanner or wrench whose end is recessed for the reception of a nut, the stalk being either furnished with a cross handle or with an eye through which a bar may be thrust; a **T spanner** or **box spanner**.

Sod.—That stratum of earth on the surface which is filled with the roots of grass, or any portion of that surface; turf; sward.

Soda, or Sodium.—One of the two principal alkaline metals, found nowhere uncombined, but most abundantly diffused as a compound; the chlorides present in sea water, and forming huge masses, as rock salt, the carbonates in extensive deposits, as the "alkali" of the plains. The chemical manufacture of carbonates, sulphates, and caustic soda is most important; as these compounds are used in immense quantities in soap and glass manufacture, and processes too numerous to mention. There are two general processes of manufacture: (1) the Leblanc, in which common salt is treated with sixty per cent. sulphuric acid, resulting in sulphate and hydrochloric acid, which acid, the familiar spirits of salts, is condensed and used to form chlorine gas for bleaching powder. The sulphate is fused together with chalk or limestone and small coal, forming black ash, from which the carbonate is washed; (2) the Solvay or ammonia process, in which strong brine is saturated with ammonia and then decomposed by carbon dioxide, forming carbonate of sodium and ammonium chloride or sal ammoniac, which latter is distilled with lime to recover the ammonia.

Soda Ash.—The trade term for sodium carbonate.

Soda Fountain.—In a locomotive, a term applied to the manifold or fitting on top of the fire box, which supplies steam to all the auxiliary pipes.

Soda Furnace.—More commonly known as *black ash furnace*. A rotary furnace used wherein sodium sulphate, chalk, slaked lime and small coal are burned together.

Sodium Carbonate.—This substance is known in its hydrated form as *washing soda*, and is made on an enormous scale by either one of two processes, the Leblanc and Solvay. In the older Leblanc process, sodium chloride or common salt is heated with sulphuric acid in iron pans, resulting in sodium acid sulphate and hydrochloric acid gas; the sulphate and unchanged salt are reheated in a reverberatory furnace, producing sodium sulphate or *salt cake* and more hydrochloric acid gas. The gas from both stages is led into water forming commercial *hydrochloric acid*. The *salt cake* is mixed with powdered coal and lime, and burned in a rotating reverberatory furnace, resulting in a melted mass, known from its color as *black ash*, which is composed of sodium carbonate and calcium sulphide. The black ash is boiled with water, dissolving out the sodium

carbonate, the insoluble calcium sulphide being deposited; the solution is known as *tank liquor*, and the solid as *alkali waste*. Part of the tank liquor is used in making *caustic soda*, the remainder is treated with carbon dioxide obtained by heating limestone, the liquid crystallizing; these crystals are fished out, heated to drive off their water, and become *soda ash* or commercial sodium carbonate.

Sodium Chloride.—Common salt; a natural compound of sodium, occurring in an impure form as rock salt, and constituting about one-fortieth of the weight of average sea water, whence it is extracted by evaporation. In addition to its manifold uses, in connection with the preparation of food, this salt is the source whence sodium carbonate and caustic soda are derived, constituting the base of the immense alkali industries.

Sodium Chloride Brine.—A strong solution of common salt, used for preserving meat, and for a circulating medium in mechanical refrigeration.

Sodium Hydroxide.—Otherwise known as *caustic soda*. It is prepared from the *tank liquor* of the Leblanc process, or from a sodium carbonate solution, by heating with *milk of lime*. Calcium carbonate separates out, a weak solution of caustic soda remaining; this is concentrated in iron pans until it has attained the desired consistency or strength, and is then cast in moulds.

Sodium Nitrate.—A natural compound of sodium, occurring in immense quantities in beds just below the surface soil in Southern Peru and Northern Chili, hence known as *Chili saltpetre*.

Soffit.—In architecture, the under surface of an arch, or the under horizontal surface of an architrave between pillars. Also the under surface of an entablature, the underside of a flight of steps, etc.

Soft.—Not hard, easily yielding; not rough or harsh to the touch; easily crushed or manipulated; plastic, easily cut or machined, annealed or decarburized.

Soft Brass.—In metals, brass which has been annealed after drawing and rolling; used for purposes requiring *ductility*.

Soft Brick.—This embraces those bricks not hard enough for outside walls and includes *soft, salmon, backing up, pale, light, chimney, filling in, inside wall, and foundry brick*.

Softener.—In drawing, a double color brush used by draughtsmen for shading.

Soft Grit.—In tools, a *grindstone* of soft and porous texture.

Soft Iron.—In metals, iron which can be shaped with ordinary cutting tools or abraded readily with files. The quality is due to the amount of carbon present and the manner of its combination, and also to the mode of crystallization. Iron which contains practically no carbon, as malleable iron, is very soft, so also is iron which contains the maximum of carbon, as foundry pigs, which may contain as much as 4 or 5 per cent. Carbon when present in the graphitical condition makes a soft iron, but a very much smaller proportion, when in the combined state, yields white iron, which is extremely hard. Iron allowed to cool slowly in sand is soft, while the same iron cooled rapidly against a metallic *chill* is hard. Soft iron is used for ordinary castings which have to be machined; tough, slippery and hard iron being reserved for special classes of work. Where it is necessary to machine castings of hard iron, grinding or cutting by means of an extremely slow feed is resorted to.

Soft Metal.—A term expressive of the density of the particular metal in relation to the purpose for which it is required. Metals are soft when they are more ductile, more elastic, and more easily cut, than the same metals when hard. Hard, brittle metals are rendered softer by annealing, by judicious cooling, and by chemical changes affecting the relative proportions of foreign metallic or non-metallic substances, which are always present in variable quantities.

Soft Patch.—A patch or covering over a leak or defect which is fastened with bolts, in contradistinction to a hard patch, which is riveted.

Soft Soap.—In machinist work, soft soap is used for the lubrication of the wooden patterns of pipes and columns while turning in the lathe and supported by a *steady*, the soap being rubbed into the bearing of the steady to prevent heating and burning of the wood. Used also in the mixing of soap suds.

Soft Solder.—A solder fusible at comparatively low temperatures, as various alloys of lead, tin, and bismuth, which melt at from 200° to 500° Fahr.

Soft Steel.—A tenacious, bending, equal-grained alloy of iron; low carbon steel.

Soft Water.—A water in which soap readily dissolves, forming a lather without being precipitated. *Rain water* is the softest natural water.

Soft Woods.—In timber, the soft woods employed in machine work are *pine*, both yellow, red and white, *spruce*, *white wood*, etc.

Soggy.—Soaked; saturated with water or moisture; as, *soggy timber*.

Soil.—In plumbing, a composition of lamp-black and size, which is painted around parts to be soldered, to prevent the adhesion of the melted solder, except to its proper place, and thus give a neat and finished appearance.

Soil Pipe.—In plumbing, a vertical pipe which conveys away the waste from water closets, etc.

Solar.—Of or appertaining to the sun; as, *solar* heat or *solar* rays, etc.

Solar Engine.—A motor, in which the rays of the sun are concentrated, by means of mirrors or lenses, upon a boiler which evaporates the necessary water into steam, this driving the engine. Others are operated by atmospheric air, heated also by the sun's rays; hence, *solar* engine.

Solar Lamp.—Another name for the Argand burner. It has a tubular wick and central duct, which admits air to the interior of the flame.

Solar Oil.—A trade name given to the petroleum distillate, which comes over immediately after the kerosenes or burning oils. Solar oil is used for gas enrichment.

Solar System.—The sun and its attendant planets and planetoids, with their satellites. In order, these are Mercury, Venus, Earth, Mars, the asteroids or minor planets, numbering over 300, Jupiter, Saturn, Uranus and Neptune. The earth has one moon, and each of the superior planets has from two to seven moons or satellites, the inferior planets, Mercury and Venus, having none.

Solder.—A metal or metallic composition for uniting the surfaces of metals; a metallic cement.

Soldering.—The act or process of forming joints upon or between metallic surfaces, by means of a fusible alloy or solder, whose melting point is lower than that of the metals sought to be united. After careful cleansing, a *flux* is applied to prevent oxidation while heated, a suitable quantity of solder is fused on the joint, by a heated copper bit or by the blow pipe flame, according as to whether soft or hard solder is employed. The soft solder easily follows the track of the iron, along the heated parts, by surface tension, but the hard solder requires more careful preparation and manipulation.

Soldering Bolt.—A copper bit, used when heated by tinsmiths and plumbers, to apply soft solder to a seam or joint.

Soldering Flux.—A material used to assist in the removal of oxides, etc., which form on metallic surfaces while heated, during the process of soldering, and assist the solder to run on the joints. *Resin* is used for electrical connections, and either it or a solution of *zinc chloride* is used for soft soldering; powdered *borax* is used with the blow pipe flame in hard soldering.

Soldering Nipple.—A short piece of brass pipe flanged at the end for connecting a lead pipe to a screwed lip union.

Solder Pot.—A metal vessel in which solder is melted for plumbers' use.

Soldiers.—In founding, strips of wood nailed to the cross bars of a flask, or wedged tightly between them to assist in retaining the sand in a deep mould.

Sole.—1. The bottom or bearing part of any object.

2. In machinery, the top or floor of a bracket, on which a plumber's block rests.

3. In marine engineering, the plate which constitutes the foundation of a marine steam engine and which is bolted to the keelsons, usually called the *bed plate*.

4. In hydraulics, the lower edge of the barre of a turbine or water wheel.

5. In mining, the seat or bottom of a passage in a mine.

6. In metal working, the floor or hearth of the metal chamber in a reverberatory, puddling or boiler furnace.

Sole Moulding Machine.—One in which the sole of a boot is pressed, to conform to the shape of the last upon which the boot is to be assembled.

Sole Piece.—In shipbuilding, an additional piece on the lower end of a rudder to make it level with the false keel.

Sole Plate.—1. The bed plate of a marine engine.

2. A base plate upon which a pillow or plumber block is mounted, frequently provided with wedges, etc., for vertical adjustment.

Solid.—That which possesses length, breadth and thickness.

Solid Blows.—In machinist's work, dead non-elastic blows, imparted by a hammer to a sheet of metal, or similar solid body, which rests upon a firm and solid support. The effect of a solid blow is to indent or thin the metal and spread it out over a large area. Solid blows are imparted to wedges, nails, keys, cogs, etc., by holding the hammer very firmly when striking.

Solid Brace.—A name sometimes given to a *crow foot* or Y brace in a boiler, as it has to be worked or forged out of a solid piece of iron *without welding*.

Solid Emery Wheel.—In tools, a wheel built wholly of emery, to distinguish it from a wheel in which the powder is laid on a center of wood.

Solidification.—In physics, the passage of a liquid or fluid to a solid state, by freezing, crystallization, etc.

Solidity.—In physics, the solid contents of a body. The solidity of all bodies can be obtained by calculation, and it is often necessary to do so to be able to obtain their *mass* and *weight*.

Solid Pattern.—One which reproduces the form and size of the object to be made, as well as its outline or linear dimensions.

Solid Piston.—An engine piston which is a solid disc, instead of being built up in separate portions. The circumference of the disc is recessed for the reception of spring rings.

Solid Reamer.—In machinist's work, a fluted tool used for finishing and truing cored and drilled holes; used in a socket or with a wrench.

Solids.—Having a fixed form; hard; firm; compact; opposed to *fluid*, *liquid*, or to *plastic*, like clay, or to *incompact*, like sand.

Solid Tool.—In machine shop work, an ordinary tool for metal turning, in which the cutting point is one with its shank; as distinguished from the smaller tool *points* used with a tool holder.

Solstice.—The point in the sun's annual circuit when it is farthest from the equator, north or south, the former being the *summer solstice* and the latter the *winter solstice*; so called, because the sun then apparently stands still in its northward or southward motion. The times of the sun's passing the solstices are about June 21 and December 21.

Solubility.—1. The property or capacity of being dissolved; as, by an acid, by water, etc.; capability of being taken up as a solution.

2. The capability of solution, as of a proposition or problem.

Soluble Glass.—A thick syrupy liquid made by melting together sodium carbonate and siliceous sand. It may be mixed with water, and if painted over a wall, is decomposed by the action of the carbon dioxide in the air, a film of silica or silicate being left, forming a hard protective surface or enamel on the wall. Also known as *water glass*.

Solution.—The action of an attraction between one or more solids and a fluid when brought in contact, by which the former become themselves fluid, and are diffused through the latter without change or loss of properties; the state of a body as thus diffused. When this attraction is so completely satisfied that no more of the solid will be dissolved, the fluid is said to be *saturated*.

Solvay Process.—The ammonia process of manufacture of sodium carbonate. A strong solution of sodium chloride is saturated with ammonia gas, the liquor being cooled during the process. The solution is forced into high towers by compressed carbon dioxide, and there it meets another ascending current of carbon dioxide under a pressure of two atmospheres, the exterior of the tower being cooled the while by means of a stream of water. The solution is converted into sodium bicarbonate and ammonium chloride, the former being less soluble, crystallizes out as it forms, the latter remaining in solution. The ammonium chloride solution is heated with slaked lime, giving up ammonia for use in the first stage; the bicarbonate is filtered off, heated by steam, forming sodium carbonate and carbonic acid. The carbon dioxide from the bicarbonate and that which escapes from the tower are both collected and used over again; the process thus being singularly economical and resulting in a product 98 or 99 per cent. pure.

Solve.—To explain; to resolve; to unfold; to clear up; as, to solve a question; to solve difficulties or a problem.

Solvent.—Having the power of dissolving; as, a solvent fluid.

Somehow.—In one way or another; in some way not yet known or designated; by some means; as, the thing must be done *somehow*.

Somewhat.—More or less; a certain quantity or degree, indeterminate; a part, more or less; something.

Soot.—A black substance formed by combustion, or disengaged from fuel in the process of combustion, rising in fine particles, and adhering to the sides of the chimney or pipe conveying the smoke; strictly, the fine powder, consisting chiefly of carbon, that colors smoke, and which is the result of imperfect combustion.

Soot Door.—In steam engineering, a square iron door inserted in an iron

frame, built into the brickwork of boilers of the horizontal type, through which the periodical accumulations of soot are removed.

Sorbite.—In steel tempering, a condition or state of carbon steel produced when the metal is annealed slowly after hardening.

Sort.—Any number or collection of things characterized by the same or like qualities; a kind of species.

Sorter.—A person employed in assorting materials or products of various manufacturing processes; one who removes impurities from raw materials by hand, or removes defective articles from the finished goods.

Sough.—1. In civil engineering, a small drain at the foot of an embankment, to convey the surface water from it into a side drain.

2. In mining, an adit or level; a nearly horizontal passage or tunnel giving access to a mine, and draining off water.

Sound.—1. A phenomenon produced and transmitted by the vibrations of particles of matter, which is detected by the sense of hearing.

2. Complete, intact, perfect; free from defect or injury; flawless.

3. To ascertain depth; as, of a body of water, by means of a plummet and line.

Sounding.—In navigation, to ascertain depths by means of a weighted and marked line, called the *lead line*.

Sounding Apparatus.—A machine for registering depths at sea. Those used to ascertain great depths employ very fine wires, in order to obviate deflection by ocean currents, and have detachable weights which are automatically released as the sounder touches bottom. Sometimes on ship board, the sounding is effected by means of a glass tube, into which water is forced by the pressure of the column of water compressing the air already within the tube. The height to which the water ascends is shown on nitrate of silver paper and read off against a scale. This sounder is attached to the ordinary deep sea lead, or is used from a wire attached to a special winch on the poop.

Sounding Pipe.—In civil engineering, a pipe used to drive in the ground and obtain samples of formation, so as to sound what kind of material is in lower layers or at what depth the rock is formed.

Sounding Platform.—In a vessel, a small stage, rigged over the side, on which the leadsmen stands.

Soundings.—A ship is said to be in soundings when the bottom can be reached with the deep sea lead, or less than 100 fathoms.

Sour.—In bleaching, a weak bath of sulphuric or hydrochloric acid, used in treating the fabric.

South.—The opposite of north. The direction contrary to that in which the magnetic needle points in the northern hemisphere, or the direction in which the sun lies at noon, in the United States or other countries of similar or greater northern latitude.

Southern Hemisphere.—That half of the world which lies south of the equator.

Sow.—In a furnace, the main trough, or the body of metal contained therein, leading from the tap hole of a cupola, and from which ramify the passages leading to the moulds in casting; or to the shallow ditches in the flow, which receive the *pigs* of cast metal.

Sower.—A machine for sowing broadcast; that is, strewing the seed widely over the land.

Space.—1. The boundless extension of the universe.

2. An interval between two objects or that between two points.

Space Washer.—In mechanics, a disc having a central hole put on a mandrel, or the line between objects that it is desired to maintain at a given distance apart.

Spacing Punch.—1. A machinist's tool consisting of two center punches whose distance apart may be regulated by a thumb screw, similar to spring dividers, enabling a series of dots to be punched at uniform distances, one point of the tool being placed in the dot last made.

2. A multiple punching machine provided with an adjusting motion, whereby the various punches can be instantly set to some desired uniform pitch.

Spade.—1. An implement for cutting and digging into the earth. It differs from the shovel, which it much resembles, in that its blade is much flatter, and does not turn up at the edges, thus being more suitable for cutting the soil, etc., and less so for throwing it to a distance when cut.

2. A chisel like implement, used in whale fishing to cut blubber and whalebone out of the fish.

Spall.—1. In masonry, to dress stone roughly by chipping off small flakes.

2. In mining, to break ore into small pieces and select the good ore from the veinstone.

3. A small flake of stone or broken piece of ore produced by spalling.

Spalling Hammer.—In masonry, a heavy hand hammer with a chisel point used to rough-dress stone.

Span.—1. A measure of length, equaling six inches.

2. The reach or stretch of a girder or bridge, between supports.

Span Dogs.—A pair of timber dogs linked together at one end by means of a ring. The dogs span or straddle the log, the fangs are driven into the wood on either side, thus grappling it for hauling or hoisting.

Spandrel.—In architecture, the flanks of an archway, or the triangular piece between two arches.

Spanish Mahogany.—A variety of mahogany, with a figured grain, obtained principally from Cuba and San Domingo.

Spanner.—A wrench or key for turning nuts; this is a general term, being qualified according to the various descriptions in use, such as *ring spanner*, *T spanner*, *coupling spanner*, etc.

Spanner Rack.—An angle bar placed in some convenient position and slotted to hold spanners or keys.

Span Roof.—In building, one having two inclined sides.

Spar.—1. A long, comparatively slender, round stick of timber such as is used for the masts, yards, booms, etc., of a vessel; or a similar object made of steel tube.

2. A miner's term for any glittering mineral; more especially those which are crystallized.

Spare Gear.—Extra parts of machinery carried on shipboard and elsewhere to replace broken or worn pieces which would be likely to cause delay or danger at sea or in isolated localities. Such

pieces must all have been fitted in place, and be exact duplicates of those already in use.

Spare Parts.—In machinery, signifies the supply of duplicate portions of machinery together with the order to which they belong. It is customary to include spare parts with work which is designed for shipping, and especially for sea going engines; the *parts* consisting of those which wear out rapidly and therefore require frequent replacement, or those vital parts upon which the efficiency of the machine or engine mainly depends, and which, in the case of a break down, it would be difficult or impossible to replace immediately.

Spark.—In mechanics, a small particle of fire or ignited substance which is emitted from bodies in combustion.

Spark Advance.—In an internal combustion engine, an advance given to the spark ignition to ensure complete combustion at the beginning of the power stroke.

Spark Arrester.—1. In steam engineering, a globular cage of galvanized iron wire, or a curved plate of sheet iron, put above the chimney of a portable engine or crane, to arrest and throw back the sparks.

2. A grating placed across the smoke box, and beneath the blast nozzle in locomotives, to arrest the upward flight of sparks.

Spark Ejector.—In a locomotive, a funnel or hopper attached to the bottom of the smoke box, provided with a flushing pipe from the boiler below water level. By means of this, accumulated sparks, cinders, etc., are blown from the smoke box.

Spark Gap.—The distance between the two metallic points in a spark plug. The amount of opening varies from about $\frac{1}{16}$ in. to $\frac{1}{8}$ in.

Spark Ignition.—The operation or method of firing the explosive charge in an internal combustion engine, by means of an electric spark.

Sparking Circuit.—The electrical wiring of a gasoline engine or of a motor car connecting the dynamos, accumulators, induction coils and sparking devices where-by ignition of the charge is effected.

Sparking Coil.—An induction coil as used with an internal combustion engine; also called *spark coil*, *induction coil*, etc.

Spark Plug.—A plug of some non-conducting material, such as lava, screwed into the wall or head of a gas engine or motor cylinder; it holds and insulates the two German silver or platinum-iridium points between which the igniting spark leaps.

Spark Regulator.—A device for controlling the spark advance. Many gas and gasoline engines effect their governing by regulating the timing of the spark, advancing it as more power is required, retarding it as the demand for power decreases.

Spathic Iron Ore.—A mineral resembling *spar*; especially having cleavage.

Spatter.—To throw water or other liquid in drops; to splash so as to wet or soil; sprinkle; bespatter.

Spatula.—An implement shaped like a knife, flat, thin and somewhat flexible, used for spreading paints, putty, etc.

Spawl.—A splinter or fragment, as of wood or stone.

Speaking Trumpet.—A conical, flaring mouthed tube or funnel employed for intensifying the sound of the human voice, as in giving commands, or hailing ships at sea; a *megaphone*.

Speaking Tube.—A tube for conveying the voice to moderate distances; as, from one floor to another of the same building, or from a ship's bridge to the engine room. The pipes are made of ordinary tubing, sheet metal, or gutta percha, and are provided with whistles in the mouth pieces at either end, so that attention may be called by a preliminary blast.

Spear.—In pumps and hydraulics, a name given to the long wooden rods of deep well and mining pumps.

Spear Rod.—In mining, the main or engine rod of the pitwork, to which the various series of pumps are connected.

Spear Point Chisel.—A wood turner's chisel, with a sharp triangular point.

Special.—1. Particular or individual; the reverse of general.

2. Of a variety or kind particularly distinguished from others.

3. Out of the common; something happening or caused to be, or take place on account of unusual circumstance.

Speciality.—That which is the special or particular mark of any person or business; that for which a person is distinguished, or which he makes an object of special attention.

Specie.—Coined money, as distinguished from *bullion*, which signifies the precious metals in ingots or bars.

Specific.—A particular sort or kind; definite; limited; possessing the peculiar property or properties of a thing.

Specification.—In erecting, a statement of particulars; a document setting forth the various requirements, conditions, and stipulations with regard to dimensions, quality of material, class of workmanship, tests or trial performance, of anything about to be manufactured or built; such a schedule of particulars is usually furnished to would be contractors or furnishers, by the person or corporation desirous of being supplied, or by the technical advisers of the latter.

Specific Gravity.—The weight of a given substance relatively to an equal *bulk* of some other substance which is taken as a standard of comparison. Water is the standard for liquids and solids, air or hydrogen for gases. If a certain mass be weighed first in air then in water, and the weight in air divided by the loss of weight in water, the result will give the specific gravity; thus, taking a ten pound piece of cast iron, its weight, suspended from the scale-pan in a bucket of water, will be 8.6 lbs., dividing 10 by the difference 10—8.6 or 1.4, the answer will be 7.14, which is the specific gravity of cast iron.

Specific Gravity Bottle.—An instrument of measurement so graduated as to contain 1000 grains of pure water. When it is filled with spirits of wine and weighed in a balance (together with a counterpoise for the weight of the bottle, which of course is constant), it will weigh considerably less than 1000 grains; in fact, the bottle will contain only about 917 grains of proof spirit; therefore, taking the specific gravity of water as unity, 1 or 1,000, the specific gravity of spirits of wine is 0.917. If, on the other hand, the bottle be filled with sulphuric acid, it will weigh about 1850 grains; hence, the specific gravity of sulphuric acid is said to be 1.850.

Specific Heat.—The capacity of any substance for receiving heat as compared with another which is taken as a standard, this being generally water. Thus, the same quantity of heat which will raise one pound of water 1° Fahr., will raise about $\frac{1}{4}$ pounds of cast iron 1° Fahr., so, the specific heat of water being taken as 1.000 that of cast iron is 0.241.

Specific Volume.—In physics, the volume of a gas or vapor compared with that of the liquid from which it is generated.

Specimen.—An example or illustrative part; an individual thing which is typical of a class or group; a portion of the whole submitted to tests to determine the qualities or physical properties of the remainder.

Specimen Bar.—In civil engineering, a length of bar of any material specially prepared for testing in a testing apparatus. Bars are either provided with shouldered ends to be held in *bridles* or clips, or are screwed into their bridges.

Specimen Plate.—In civil engineering, a piece of plate of any material, specially prepared for testing in a testing machine. Plate specimens are embraced at the ends, the breadth at the ends being increased to maintain the sectional area, and so compensate for the loss of strength due to the holes made for attachment. The central portion of the plate is parallel. The general length is eight inches and the area of original section, as nearly as possible, one square inch.

Spectacle Piece.—A boiler patch, so called, used to repair a crack situated between the tube ends of a boiler. The patch piece is machined out to encircle the tubes adjacent to the crack, or in other words, to be a duplicate of a portion of the tube plate cracked. These plates after being carefully fitted, are then screwed or riveted to the tube sheet so as to cover the crack.

Spectacles.—In steamboats with two propellers special combination brackets to sustain the shafts.

Spectroscope.—An instrument whereby a spectrum is produced from any source of light, in order that it may be examined. The rays of light are formed into a parallel beam, by means of a *collimator*, which is a tube with an adjustable slit presented towards the light, and a *lens* at or near the other end. As the light issues from the lens, it falls upon a *prism*, by means of which the parallel beam is split up into a spectrum. This latter is viewed through an adjustable telescope, the position of the various lines and bands being ascertained by means of cross-wires, scales and verniers.

Spectrum.—An image or brilliantly colored band thrown on a screen by the refraction of a beam of light through a prism. The colors merge into one another, but form seven easily distinguishable groups; red, orange, yellow, green, blue, indigo, violet; each color being produced by a different wave length of the ray, and the grouping due to the varying deviation through the prism, which is greatest with the violet and least in the red. The rainbow furnishes a familiar instance of the solar spectrum, the rays of sunlight being decomposed and refracted by the falling rain drops.

Spectrum Analysis.—When any element is burned it gives a characteristic flame,

and examination of that flame by means of the spectroscope shows that each element will give its own spectrum, composed of wave lengths peculiar to itself.

Specular Iron.—In metals, an iron which has a smooth, reflecting surface.

Speculum.—A mirror of polished metal; used by the ancients before the invention of silvered glass, and much employed nowadays in connection with surgical instruments for viewing the internal appearance of the cavities of the body.

Speculum Metal.—A hard white alloy, consisting of 50 per cent. copper, 21 zinc and 29 tin, which takes a very high polish and is suitable for mirrors. An alloy of two parts copper and one of tin with some arsenic to harden it, is also known by the same name, this second composition being employed for the mirrors of reflecting telescopes.

Speed.—The moving or causing to move forward with celerity; swiftness; quickness.

Speed Cone.—In shop practice, the stepped pulley of different diameters, by means of which the speed of a belt driven machine is varied. Also called *cone pulley*, and *stepped pulley*.

Speeder.—In manufacturing, a machine, substituting the bobbin and fly frame, by which *slivers* of cotton from the *carding machines* are slightly twisted, and thereby converted into *rovings*.

Speed Gear.—In an automobile, the change speed gear, whereby the speed ratio of the engine and rear wheels of the car is changed according to the gradient or running conditions.

Speed Indicator.—1. A device for showing the rate of speed at which a vehicle is proceeding, either by: (1) the height of a liquid column in a glass tube, the oil or water being forced up by means of a rotary pump driven by the axle of the vehicle; (2) the height to which a small centrifugal governor will rise in the same circumstances, the sleeve pulling a needle around a graduated dial. The same as *tachometer*, the latter usually indicating revolutions and not distance.

2. A portable counter for revolutions. The observer thrusts the point of the spindle of the instrument into the center left in the end of the revolving shaft, and the revolutions are registered by a train of gearing. By noting the figures at the beginning and end of a stated period, the rate of revolutions per minute is easily computed.

Speed of Ignition.—In gas engines, this has reference to the rapidity with which chemical combination takes place between the air and gas in a gas engine. The speed of ignition varies with the compression, temperature, and quality of the mixture. The speed of ignition must always exceed the piston speed in order to obtain the best results.

Speed Recorder.—In railway service, an instrument for registering the velocity of a train, in which a pencil arm, connected with a spring loaded piston, marks upon a traveling paper, at the same time showing the speed at a glance on a dial; the piston varies in its height according to the pressure of fluid pumped against it by a rotary pump driven off an axle. Also called an *engine counter*.

Speedy.—Not dilatory or slow; quick; swift; rapid in motion; as, a speedy craft.

Speiss.—A mass of metal, formed in the bottom of a crucible or furnace, consisting essentially of nickel, obtained as a residue in smelting cobalt and nickel ores with silica and sodium carbonate to make *smalt*.

Spelk.—A splint; a little rod by which a thing is kept straight; a splint for binding up broken bones.

Spell.—1. A shop term, denoting the relief of one person by another in any piece of work or watching.

2. The time during which one person or gang works until relieved; as, a *spell* at the pumps. A spell at the wheel, is called a trick.

Spelter.—1. Zinc in the form of ingots; that metal is quoted by this name in metal market reports and in business transactions.

2. An alloy of copper and zinc, mixed together in various proportions, of needle-like or granular form. This is used in brazing, and is the same as *hard solder*.

Spencer.—In navigation, a fore and aft sail abaft the foremast or the mainmast, hoisted upon a small supplementary mast and set with a gaff and no boom; a trysail carried at the foremast or mainmast.

Spend.—In mining, to break ground; to continue working.

Spent.—In mechanics; exhausted, deprived of strength; said of solutions, extracts, etc., after use in the processes to which they have been applied.

Spent Tan.—Tanbark which has been deprived of its extractive matter in the process of tanning; used as fuel, as a material for running paths, etc.

Spermaceti.—A white, brittle, wax like substance, which separates out in flakes from the sperm oil as it is taken from the whale. It is used in perfumery, in compounding medicines, and in candle making.

Sperm Oil.—A clear limpid oil found within a cavity in the skull of the sperm whale, and in other cavities in its body. It is used as a lubricant for fine and delicate machinery, for tempering steel springs, and other purposes.

Sp. Gr.—An abbreviation for *specific gravity*.

Sphenoid.—A wedge shaped crystal, bounded by four equal isosceles triangles.

Sphere or Ball.—A body whose surface has every part equally distant from a point within called its center.

Spherical.—Pertaining to a sphere or ball; having the appearance of a globe, ball or sphere.

Spherical Ball Machine.—A machine for imparting a truly spherical form to steel or iron balls, as used in *ball bearings*.

Spherical Boiler.—In steam engineering, one of globular form or made up of a number of connected globes.

Spherical Segment.—A solid figure, representing that portion of a sphere cut off by a plane. Its plane surface is therefore a circle, and its curved surface part of the envelope of the sphere.

Spherical Triangle.—In mathematics, a triangle imagined to be described upon the surface of a sphere. Its sides are arcs of the great circles of the sphere and are measured by the angles of the arc. Its trigonometrical functions, therefore, bear quite a different relation to the sides, and are treated by the science of *spherical trigonometry*.

Spheroid.—A body or figure, approaching to a sphere, but not perfectly spherical. The globe is a spheroid, being slightly flattened at each pole.

Spheroidal State.—In physics, the condition of a liquid, as water, when being thrown on the surface of a highly heated metal, it rolls about in *spheroidal drops* or masses, at a temperature several degrees below ebullition and without actual contact with the heated surface. This phenomenon is due to the repulsive force of heat and the intervention of a cushion of vapor.

Spherometer.—An instrument for measuring the curvature of surfaces.

Spherule.—A little sphere or spherical body; as, quicksilver when poured upon a plane, divides itself into numberless minute spherules.

Spick and Span.—A shop term, denoting quite new; that is, as new as a spike or nail just made and a chip just split; brand new.

Spider.—In steam engineering, a double gab in certain types of valve gear having four arms, whose inclined surfaces guide it on to either rock shaft pin.

Spider Wheel.—In machinery, a wheel or pulley having open light arms of wrought iron or steel.

Spiegel.—A shop abbreviation for *spiegeleisen*.

Spiegeleisen.—A white cast iron containing eight to fifteen per cent. of manganese, used largely in connection with the Bessemer and open hearth process of making steel.

Spigot.—1. A cock or tap fixed to a barrel to draw off its contents.

2. The tapered male part of an inserted joint; as, in plumbers' wiped joints.

Spike.—A very large nail:

12d spikes are $3\frac{1}{2}$ inches long, 45 to the pound.
16d spikes are 3 inches long, 28 to the pound.
20d spikes are 4 inches long, 20 to the pound.
30d spikes are $4\frac{1}{2}$ inches long, 16 to the pound.
Railway spikes are larger and of various patterns.

Spike Drawer.—In railroading, a spike extractor; a crowbar with a claw; the fulcrum piece is based upon the tie, and hooked over the rail; the claw of the lever lifts the spike by the head.

Spile.—1. In civil engineering, a pile.

2. In cooperage, a small plug of wood for stopping the spile hole of a barrel or cask. The spile hole is a small aperture made in the cask when placed on tap, usually near the bung hole, to afford access to the air, in order to permit the contained liquid to flow freely.

3. In maple sugar manufacture, a spout for sugar water, the sap of the sugar maple tree, which, inserted in a hole bored in the tree, conducts the water to a trough or pan placed beneath to receive it.

Spill.—1. A shop term, to suffer to fall or run out of a vessel; to lose, or suffer to be scattered; applied to fluids and to substances whose particles are small and loose; as, to *spill* sand or water.

2. A peg or pin for plugging a hole, as in a cask; a spile.

Spill Gratings.—In architecture, gratings made of light round bars of steel or iron.

Spilling.—In mining, a manner of supporting the roof or sides of a working where the ground is loose. Poles (spills) or boards (laths) are driven forward from the last frame of timbering, with blows from a sledge, while the ground is picked away; a fresh frame being inserted to support the spilling as soon as sufficient advance has been made.

Spill Trough.—In brass founding, a trough used to receive the brass poured out from the crucible to take away the scum, or what may be left after pouring the mould.

Spillway.—In hydraulic engineering, an overflow or waste weir, for relieving excess water impounded behind a dam or embankment.

Spin.—1. To draw out and twist into threads, either by the hand or machinery; as, to spin wool, cotton, or flax.

2. To form as a thread or filament, by the extrusion of a viscid, transparent liquid, which hardens on coming in contact with air; said of the silk worm, and the like.

3. To shape, as metal, by revolving, as in a lathe, and pressing against it with a roller or hand tool.

Spindle.—1. The long, round, slender rod or pin in spinning wheels by which thread is twisted, and on which, when twisted, it is wound.

2. A slender, pointed rod or pin on which anything turns; an axis or arbor; as, the spindle of a millstone, a pinion, or a capstan.

Spindle Valve.—A lift valve guided by a central spindle or stem.

Spinel.—In manufacturing, bleached yarn for the manufacture of the broad linen tape known as *inkle*.

Spinnaker.—A triangular sail set abreast of the mast, its foot being extended by means of a boom outstretched from the

side. The use of the spinnaker is almost entirely confined to cutters (sloops) and is generally only set when running before the wind, or *wing and wing*.

Spinning.—1. Rapid rotation, or a rapid twirling motion.

2. The process of drawing out and twisting fibers into a yarn, thread or cord; as, in the manufacture of cotton, wool or flax.

Spinning Jenny.—An engine or machine for spinning wool or cotton. It consists essentially of a large number of spindles, made to revolve simultaneously by bands connecting them with a common driving wheel or cylinder.

Spinning Metal.—The process of forming circular articles from soft ductile sheet metal by pressure on the circumference while they are revolving in a lathe. A wooden chuck or mould of the interior surface is attached to the fast headstock, while the sheet of metal is pinched between the chuck and the loose headstock. As mould and metal revolve, pressure is applied to the latter, by means of various tools and burnishers, which cause the metal to conform to the shape of the mould. The latter is often made up of concentric pieces fitting into one another, which may be drawn out one by one, as required by the progress of the manufacture.

Spinning Wheel.—A machine for spinning yarn or thread, in which a wheel drives a single spindle, and is itself driven by the foot acting on a treadle.

S Pipe.—In pipe fittings, a pipe whose outline is roughly that of the letter **S**, used for connecting parallel lengths of straight piping. Also called *offset elbow*.

Spiral.—Winding like a screw; winding round a cylinder or other round body, in a circular form, and at the same time rising, or advancing forward.

Spiral Clutch.—A friction clutch in which engagement is effected by the constriction of a helical, ribbon like spring around a drum or pulley.

Spiral Conveyer.—In grain and flour making machinery, one in which materials are transported by means of a helix or worm revolving within a trough.

Spiral Curve.—A plane curve which winds about and recedes, according to some law or definite proportion, from its point of beginning, which is termed its center.

Spiral Cutter.—A milling cutter, the serrated edges of which form part of a helix instead of being parallel to the axis or longitudinal.

Spiral Gear or Gearing.—Gearing consisting of wheels working together with their axes at an angle with each other, double that of the direction of the teeth with the axis; a kind of gearing sometimes used in light machinery instead of bevel gearing, to change the direction of motion.

Spiral Punch.—One with a true spiral terminating in a point; the object being to punch the metal gradually, thus minimizing the distress caused by the operation of punching.

Spiral Spring.—In mechanics, a coil whose rounds have the same diameter, and which is generally utilized by compression or extension in the line of its axis. The balance spring of a chronometer is spiral, and is utilized by an expanding and contracting action in a plane at right angles to the axis.

Spiral Wheel.—A wheel having its teeth cut at an angle with its axis so that they form small portions of screws or spirals.

Spiral Winged Valve.—A lift valve, the wings of which, instead of being at right angles to the seat, are arranged as sections of a spiral of very long pitch. The advantage is that the valve is turned round on its seating to a slight degree at each lift, thus rendering the wear uniform.

Spire.—In architecture, the termination or roof of a tower when of a pyramidal or conical form, the sides converging to an apex.

Spirit Colors.—In calico printing, those obtained with the use of spirits; that is, the various acids of tin.

Spirit Compass.—A type of mariner's compass, used on boats or small craft, in which the bowl is supported by alcohol, to check oscillation.

Spirit Lamp.—A lamp burning alcohol; used for many purposes in the arts where heat rather than light is required.

Spirit Level.—One in which the adjustment to the horizon depends on the position of a bubble, or small vacant space,

in the upper side of a glass tube, which is slightly curved and nearly filled with alcohol or ether.

Spirits.—In mechanics, a strong distilled liquor or liquid, especially alcohol; as, in case of wounds, to apply spirits to, or treat with spirits.

Spit.—A small point of land running into the sea, or a long, narrow shoal extending from the shore into the sea; as, a spit of sand.

Splash.—To strike and dash about water; water and dirt thrown upon anything.

Splash Board.—A guard in front of a vehicle to prevent the driver or occupants from being splashed by mud from the horses' heels.

Splasher.—A guard or casing over the wheels of a locomotive.

Splash Lubrication.—A system of lubrication, especially employed in single acting engines, the moving portions being enclosed in a tight casing filled with oil, to the level of the shaft. The cranks dip into the oil at each revolution and splash the lubricant over the moving parts and also the cylinder walls, where no cover and stuffing box is fitted. Openings are made in the middle of the crank-pin and crosshead brasses, so that the oil has free access to them.

Splay.—In carpentry, to form a sloping surface larger than a chamfer; to make an oblique angle with another surface on any object or part of a building.

Splice.—1. To unite, as two ropes or parts of a rope, or as one to another, by a particular manner of interweaving the strands; the union being either between two ends, or between an end and the body of a rope; to unite by lapping two ends together and binding, or in any way making fast.

2. To connect, as, pieces of wood or metal, such as beams or railway bars, by means of overlapping parts bolted together, or so shaped as to hold themselves in continuity; to scarf.

Splice Bar.—In a railroad, a fishplate for rails; a steel bar bolted on each side of adjacent rails to give strength to the joint, and provided with slotted or oval holes to permit the movement due to expansion of the rails. Also called a *splice piece*.

Spline.—1. A long, thin, flexible strip of wood or hard rubber used by draughtsmen in laying off curves for ships' lines, etc. The spline is held down at various points by lead weights, and bent to suit the temporary purpose, for drawing the required line.

2. A feather or long fixed key set in a shaft, so that the hub or part fitted on the shaft may be slid along it lengthwise, but must always revolve with it.

3. A thin strip or tongue of wood, fitting into a groove on one piece of plank, to match it with the corresponding groove in its neighbor, as in making partitions, skirting, etc., to exclude air currents.

Splined Joint.—A joint made with a spline fitting into a groove in each plank, as in match boarding.

Splined Shaft.—A shaft provided with a long feather way; as, a splined feed rod on a lathe.

Splint.—1. A piece split off; a splinter.

2. A thin piece of wood, or other substance, used to hold or protect an injured part, especially a broken bone when set.

Splinter.—A strip or fragment of anything broken, shivered or split off, generally in the direction of its length, or of its fiber.

Splinter Gratings.—Heavy hinged gratings, of cast iron or steel, disposed over the machinery of a warship, to keep it free from debris in time of action.

Splint Machine.—A machine for making thin sheets or strips of wood, as; for basket making; a slivering machine.

Splint Plane.—In wood working, a plane for removing thin strips of wood from boards or blocks. These strips are used for making small boxes and the like, the thickness being regulated by the protrusion of the plane iron. A channel within the stock leads the strip away in a straight line, to avoid curvature and possible breakage.

Splints.—Appliances used in treating fractures and for supporting bones in their natural position until a cure is effected. Splints are made of wood, iron, pasteboard, gutta percha, felt, wire, tin, or bark. Temporary splints may be made with umbrellas, walking sticks, cigar boxes, folded newspapers, policemen's clubs, etc. Splints should be well padded with cotton, wool, tow, flannel, or lint.

Split.—1. To divide longitudinally or lengthwise; to separate from end to end by force; to rive; to cleave; as, to split a piece of timber; to split a board.

2. In weaving, one of the canes, quills or wires that go to make up the reed of a loom, through which the warp threads pass, and which beats up the filling after each shot or pick; also known as dent.

Split Draught.—In steam engineering, in an internally fired boiler, the gases pass through the furnace tubes to the back of the boiler, whence they dip underneath into an external flue of brickwork and so pass to the front end. Thence they divide or split to right and left, into two distinct brick flues placed upon each side of the boiler, which conduct them to the chimney. This is called *split draught*, to distinguish it from *wheel draught*. Dampers are placed in these side flues at the further ends.

Split Key.—In machinery, a key which is split on one end similarly to a *split pin*, to lessen the tendency to work out of its bed.

Split Pin.—A species of cotter, used to prevent nuts and small parts working loose on an engine or machine. A piece of half round wire, steel or copper, is bent to form a pin with an eye in it at one end; this is inserted in a drilled hole through the bolt, just below the lock nuts, and has its end opened to prevent itself from working out, while it prevents the nuts from jarring off.

Split Pulley.—A belt pulley, made in two halves joined to each other by bolts, for convenience in fixing on shafting already in position.

Splitter.—A small chisel used by masons, having a cup shaped or hollow end; used with a hammer for carving and lettering, and in working marbles.

Splitting Plates.—In a foundry, thin plates of wrought iron or of cast iron placed in a foundry mould, to effect the division or *splitting* of a wheel or pulley in the act of casting. To prevent adhesion of the molten metal to their faces, they are painted over with tar or with loam and black wash.

Splitting Saw.—In wood working, a circular saw for cutting up thick stuff. A *resawing* machine.

Split Wheel.—In a foundry, cog wheels are sometimes split for the same reason as pulleys. They are usually moulded as one, but split by interposing a thin plate of wrought or cast iron between the arms, by means of which, the casting is divided into two parts. The splitting takes place either through the arms, or through lugs cast on the bosses and on the inside of the rim. Sometimes the halves are moulded and cast separately and fitted together by planing.

Spoil.—To render useless by injury; to destroy; as, to spoil paper by wetting it; to have crops spoiled by insects.

Spoil Bank.—In civil engineering, a bank formed by the earth taken from an excavation; as, from a canal.

Spoke.—1. The round of a ladder.

2. The radius or ray of a wheel; one of the small bars which are inserted in the hub, or nave, and which serve to support the rim or felly.

Spoke Lathe.—A variety of copying lathe, by means of which oval or irregular wooden forms, such as wheel spokes, hammer handles, etc., are made.

Spoke Machine.—A machine or lathe used for turning spokes on the *copying* principle. The lathe has two sets of centers, the wood to be turned revolving at the same speed between the other set. The cutter and a roller are set in the same slide rest, and while the latter follows the templet, being kept pressed against it, the former follows and removes the wood, so that the latter is bound to become an exact counterpart of the templet of copy.

Spoke Nipple.—The small threaded tube which retains a cycle wheel spoke in the rim. The spokes are prevented from going through the holes in the hub by their heads, and are adjusted to proper length by means of the nipples at their other ends, in the rim.

Spoke Pointer.—A wheelwright's tool for putting a taper point on spokes, consisting of a conical cup, in the side of which is placed a cutter somewhat like a plane iron. The cup has a shank, usually adjustable to form a depth gauge, which fits a swing brace, and the conical cutter is thereby revolved on the point of the spoke.

Spoke Shave.—A kind of drawing knife for dressing the spokes of wheels, the shells of blocks, and other curved work.

Spole Frame.—In rope making, one of the three *spool holders* which carry the strands to be laid up into the rope. Each spole frame has its own apparatus for imparting tension and torsion, the three frames being combined into one rope making machine.

Sponge.—A porous or fibrous substance the skeleton of what may be regarded as a low aquatic animal, found adhering under water to rocks, etc.

Sponge Cloth.—A coarse cotton towel almost a net, expressly woven for engineers and machinists, for cleaning bright and working parts of machinery. These sponge cloths leave no lint or fluff on the working parts, and are best cleansed by boiling under pressure.

Sponge Filter.—An apparatus for mechanically separating impurities from water, by passing the liquid through a chamber filled with sponge. Such filters are adapted for clearing large quantities of muddy water, for manufacturing purposes, etc. When the filter gets clogged, the stream is turned in the reverse direction, and power is applied to the movable piston which forms the floor of the sponge chamber.

Sponge Iron.—In a rolling mill, the bloom of pasty, spongy iron taken from the puddling furnace, before it has been hammered or compressed by *shingling* under the squeezer, steam hammer or helve.

Spongy.—1. Having a cellular structure, similar to sponge.

2. In metallurgy, a defective or honey-comb like state of cast metals, due to gases which cause blow holes, or cavities in the metal.

Spontaneous Combustion.—A term which is applied when anything catches fire without the application of an external agent. When any mass of matter is slowly oxidizing and the heat generated is unable to escape, the temperature rises. The rate of oxidization proceeds with greater rapidity until the mass bursts into flame; oily waste and slack coal containing sulphur are very liable to spontaneous combustion.

Spool.—A reel or bobbin upon which a thread or yarn is wound.

Spooler.—In weaving, a machine which winds the yarn from numerous small bobbins, holding 1200 to 1800 yards, on to a large spool holding from 18000 to 20000 yards, to save trouble in warping; either through stopping to piece ends, or through undetected weak places or lumps.

Spoon.—In navigation, to be driven steadily and swiftly, as before a strong wind; to be driven before the wind without any sail, or with only a part of the sails spread; also written *spoon*.

Spoon.—An instrument consisting of a small concave basin with a handle; in founding, a spoon shaped tool used in finishing the mould.

Spoon Bit.—In carpentry, a semi-cylindrical woodboring tool used in a brace; it has a conical point, and cutting edges to its grooved barrel.

Spoon Brake.—A brake, pressing on the tire of a cycle, etc., having a shoe shaped

like a spoon. It is unsuitable for pneumatic tires, but is used in connection with those of the cushion or solid patterns.

Spot.—1. A small extent of space; a place.
2. To stain; to discolor in or with spots.

Spout.—1. To flow, to gush forth. To issue as a fountain.

2. A rounded place on the edge of a vessel, or a projecting beak for the easier pouring out of liquids.

Spout Plane.—In carpentry, a round bottomed plane for hollowing out spouting and troughs.

Sprag.—1. In carpentry, a billet of wood; a piece of timber used as a prop.

2. To check the motion of; as, a carriage on a steep grade, by putting a piece of wood or *sprag* between the spokes of the wheel.

Sprag Road.—In coal mining, a road so steep that the descending cars or tubs must be controlled by *sprags*.

Sprain.—A violent straining or twisting of the ligaments surrounding a joint, sometimes producing partial rupture but not dislocation. Treatment: Put the part in complete rest. If sprain be in joint of the arm, apply a padded splint to the inside of the limb, then place the forearm in a large sling. If sprain be in a joint of the leg, place the patient in bed, apply a padded back splint to the limb and slightly elevate it. After the limb has been put at rest, apply bandages dipped in cold water, or an ice bag, to joint. If pain be too severe, bathe joint with hot water, or apply hot bran poultices.

Spray.—1. Water flying in small drops or particles; as, by the force of the wind.

2. In founding, especially plate moulding, a set of castings as united by runners or sprues.

3. In locomotives or cars, a wooden lever used to lock the wheels instead of a *brake*.

Spray Carburetor.—A pattern of carburetor for internal combustion motors, in which the liquid fuel is atomized or sprayed through a nozzle.

The device consists of: (1) A float chamber into which the fuel enters from the supply source, the flow being regulated by a float valve maintaining the liquid at a given level. (2) A mixing chamber containing a spray nozzle, the latter connected by a small passage way to the float chamber, whence gasoline flows to the nozzle, being regulated by a needle valve. The mixing chamber has a primary air inlet and a secondary inlet which supplies additional air when necessary. The action is automatic. A throttle valve regulates the volume of the mixture supplied to the engine.

Spray Drain.—In construction, a drain made by laying under earth, the sprays or small branches of trees, which keep passages open.

Sprayer.—An implement, having a reservoir for fluid, a pump, and a connection whereby the fluid is blown forth in a shower of small drops. A name sometimes given to a carburetor.

Spray Pipe.—The perforated pipe admitting the cooling water within a jet condenser; sometimes termed the *rose* and *injection pipe*.

Spray Pump.—A pump placed on or within a reservoir, the whole usually mounted on wheels, designed to spray trees, plants, etc., with water, insecticide, etc.; also called a *garden engine*.

Spread.—To be thrust apart or further apart; as, the walls *spread* and the building fell; also, a term to express the space between the two cylinders of a *duplex pump*; as, "the spread" of the steam fire pump.

Spreader.—1. In flax manufacture, a drawing machine which doubles the flax from the heckles, and delivers it as slivers.

2. In cotton manufacture, the same as a lapping machine.

Spread Foundations.—In erecting, a method of reducing the unit pressure per square foot on compressible soils without driving piles, by splaying the foundations considerably under the footing courses. These spread foundations may be of reinforced concrete, of steel beams in a concrete mass, or a timber grillage.

Spreading Hammer.—A gold beater's hammer, the second one which he uses, with a rounding face two inches in diameter, the head weighing four or five pounds.

Spreading Plate.—In sheet glass manufacture, a flat plate or hearth stone upon which a split cylinder of glass is opened out and flattened into the sheet.

Sprengel Air Pump.—A device for attaining a very high vacuum, such as is necessary in the manufacture of incandescent electric lamps. Mercury is fed into a funnel at one extremity of a long U tube, this tube having a return bend with a longer drop leg on its other end; a nozzle situated within an annular enlargement, at the top of the drop

leg, breaks the flow of the mercury into a series of slugs with air between them. Each slug, falling down the drop leg, acts as a sort of piston, sucking the air behind it, and, as a connection on the return bend communicates with the vessel to be exhausted, the latter is speedily emptied of air. The U tubes being over barometric height, air cannot pass up them even should the pump stop. Escaping mercury from the drop leg or "fall tube" collects in a vessel which surrounds its base.

Sprig.—1. A flat taper nail without a head, used by joiners and cabinet makers.

2. A brass or iron headless nail used by shoemakers; the same as *sparables*.

Spring.—An elastic body; as, a steel rod, plate, or coil; a mass or strip of india rubber; a body of compressed air, used for various mechanical purposes, as receiving and imparting power, regulating motion, measuring weight or other force, diminishing concussion, and the like.

Spring Adjustment.—A means of imparting variable tension to compensating or balancing springs, such as are fitted to governors, safety valves, drop valves, etc. The adjustment is effected usually by means of nuts or set pins, which press on the compression caps of the spring, closing its coils together to increase the load, or allowing them to expand in order to lessen the pressure. Another plan is to make a worm wheel of one compression cap, and rotate it by means of a small worm, which causes the coils to be twisted up more or less tightly as desired.

Spring Balance.—An apparatus for measuring the intensity of the power applied to extend or compress a coiled spring. The spring itself is usually connected by suitable linkages to a pointer which moves on a graduated scale or dial. Applications of the spring balance are *steelyards, testing machines, spring loaded safety valves*, etc.

Spring Balance Valve.—In steam engineering, a form of safety valve in which the lever is attached to the end of a spring balance, instead of receiving a weight. The graduations of the balance indicate the pressure.

Spring Bows.—In mechanical drawing, small compasses made with two spring legs whose distance apart is regulated by a small through bolt and thumb screw. They are usually made in sets of three: dividers, pencil bow and pen bow.

Spring Butt.—In carpentry, a butt hinge fitted with a spring so that the door to which it is fitted may remain closed

while it is not being operated, or will automatically resume a closed position after being opened.

Spring Cotter.—Properly, a flat cotter or forelock, split at the end remote from the head, to secure it in its place. The term is sometimes applied to a round *split pin*.

Spring Crosshead.—In ammonia compressors, for the sake of safety, some makers have fitted springs into the cross-head trunk, so that they may yield, should the piston strike the cylinder end; also known as *movable head*.

Spring Dividers.—Compasses with sharp points, used in setting off work. The hinge is replaced by a loop of spring steel which tends to force the legs apart; these are held together by a bolt and thumbscrew, thus providing for non-slipping compasses with accurate adjustment.

Springers.—In architecture, the lowest voussoirs or archstones in an arch.

Spring Hanger.—In a locomotive, a stirrup or link used to connect the springs of journal boxes with the frame, either directly or through the intervention of equalizing beams or levers.

Spring Head.—In hydraulics, a fountain or source.

Springing Line.—In architecture, the line from which an arch rises. The line of the springers on the *imposts* and from which the *versed sine* or *rise* is calculated.

Spring Latch.—In carpentry, a latch that fastens with a spring.

Spring Line.—In building, that line from which the *intrados* runs towards the center or crown of an arch.

Spring Lock.—In carpentry, a lock that fastens with a spring.

Spring Pawl.—In machinery, a pawl which instead of pressing downwards by the action of gravity simply, in which case it must be placed over its wheel, is kept in contact with the wheel by means of a spring. The spring may be either external or internal, in the former case consisting of a strip of sheet metal fixed at one end, and exerting pressure at the other. In the latter case, a coiled spring enclosed within the body of the pawl, which, by its reaction against one of three faces of a triangular pin enclosed in the pawl center, maintains the pawl in either one of those three

positions, though the resistance of the spring is not so great but that the pawl can be turned round by manual force.

Spring Piece.—In steam fitting, a bent or looped length fitted into a pipe line, to permit expansion or contraction by its yielding or springing.

Spring Pin.—In a locomotive, an iron rod fitted between the springs and the axle boxes, to sustain and regulate the pressure on the axles.

Spring Plank.—In a locomotive, a transverse timber used to support the bolster springs of a wooden truck bolster. The same term is applied to the steel or iron plate taking its place in iron trucks in which the same design is copied.

Spring Pole.—In well boring, by hand, a tree or spar bent over the hole, which by its elasticity lifts the tools on the up stroke, when released; the tools being forced down by manual power, working levers or pulling on tackles.

Spring Punch.—A punching apparatus provided with a spring for drawing back the punch from the hole which it has made.

Spring Seat.—In steam pipe fitting, an elastic seat for a valve, to minimize shocks.

Spring Stay.—A preventer stay, to assist the regular one.

Spring Tool.—In a machine shop, a cutting tool used for finishing bright work, or in forming radii. The body of the tool is formed into a bend or Ω between the edge and the square part held in the rest. This bend *gives* to the inequalities of the material and so makes a smooth surfacing cut.

Spring Valve.—A spring loaded valve, such as a *safety*, *relief* or *escape* valve.

Spring Washer.—A split washer, with ends bent spring like; used to prevent a lock nut working loose.

Sprinkle. To perform the act of scattering a liquid, or any fine substance, so that it may fall in small particles.

Sprinkler.—A fire extinguishing apparatus of two types, fitted to buildings containing inflammable materials. One, a network of perforated pipes, placed under the ceilings of basements and cellars, communicating with a hose connection on the sidewalk,

so that the fire engines may connect therewith, to quench outbreaks. Also, a system of jets, perforated pipes, or the like, situated under the ceilings of the various floors, the whole connected with an elevated tank containing a large supply of water. The valves leading to each jet or sprinkling pipe, are sealed with a compound which melts at 165° Fahr., so that, if a fire starts in any place, the heat generated will fuse the seal and bring the neighboring water jets into action.

Sprinkling Bellows.—A foundry tool; a bellows with a reservoir for liquid attached to the nozzle, used to spray moulds with water, kerosene, etc.

Sprit.—A small boom, pole, or spar which crosses the sail of a boat diagonally from the mast to the upper aftmost corner.

Sprocket.—In chain or link belting, a wheel with teeth around its circumference, shaped so that they may fit into the links of a chain which the sprocket drives, or by which it is rotated.

Sprocket Chain.—A chain for transmission of power, whose links have openings to fit on the teeth of a sprocket wheel.

Sprocket Wheel.—A toothed wheel employed in the transmission of power, by means of a chain or link belting.

Spruce.—In carpentry, a kind of pine timber or lumber in general use; as, the Norway spruce and the white and black spruces of North America. The woods are known as white deal, white fir, or spruce fir, and are white to yellowish in color, and soft, with a straight grain. They are easily worked, but apt to warp, and are employed for poles and spars, flooring and general carpentry. Wood pulp, resin and charcoal are also obtained from the spruce.

Sprue.—In founding, the hole through which melted metal is poured into the gate, and thence into the mould; the waste piece of metal cast in this hole; hence, dross or scoria.

Sprue Cutter.—A small shearing machine used by brass foundries to remove sprues from their castings.

Sprung.—Strained, wrenched, cracked; as, by violent usage or by overloading; as, with a spar or boom, or the wooden handle of anything.

Spry.—A shop term, implying great power of execution; active.

Spud.—1. In excavating, an implement somewhat like a chisel, with a long

handle; somewhat like a carpenter's gouge.

2. In well boring, a tool shaped like a spade, for freeing lost or broken tools by digging round them.

Spume.—Frothy matter raised on liquids by boiling; froth; scum; also a thick foam forming on sea waves in heavy weather.

Spun Yarn.—A line or cord formed of yarns twisted together, but not laid up; used on shipboard. The tarred yarn known by the engine room staff as *marine*, is termed spun yarn by the deck, while an engineer usually designates a white flax yarn as spun yarn, that which is often plaited up for packing.

Spur.—1. Something that projects.

2. A brace connecting and strengthening a post or some other part; as, a rafter or crossbeam; a strut.

3. In shipbuilding, a piece of timber fixed on the bilge ways, having the upper ends bolted to the vessel's side above the water.

Spur Center.—The main portion of a mortise wheel, into which the wooden cogs are inserted.

Spur Gear.—In machine shop practice, a spur wheel or cog wheel with teeth around its edge pointing radially from it, and whose faces are parallel with its shaft or axis.

Spurious.—False or misleading; not proceeding from the proper or true source; thus, false coinage is equally spurious, whether made of base metal or of good metal at an improper place.

Spur Stone.—A post or block of hard stone, usually granite, set at the corners of archways, etc., to protect them from the wheels of vehicles.

Spurt.—In hydraulics, a sudden or violent ejection or gushing of a liquid; as, of water from a tube, orifice, or other confined place; a jet; a spirt.

Spur Track.—A railroad track jutting off from the main line; a *side track*.

Spur Wheel.—A cog wheel whose teeth are parallel with its axis, thus gearing with another similar wheel whose axis is parallel with that of the first. Where a large and small wheel gear together the larger is termed the *spur wheel*, the smaller, the *pinion*.

Sputter.—To throw out anything; as, little jets of steam, with a noise like that made by a damp candle wick when the flame is going out.

Spy Glass.—A small telescope for viewing distant objects.

Squabble.—A shop term, meaning to contend for superiority in an unseemly manner; to scuffle; to wrangle; to quarrel.

Square.—1. A four sided plane figure, whose sides are equal and whose angles are right angles.

2. An instrument whereby one line may be set at right angles, or the perpendicularity of a piece may be tested.

3. A shop term, signifying 90 degrees; exact, etc.

Square Center.—In machine shops, a tool for forming and enlarging the centers in the ends of a shaft or bar which has to be turned in a lathe; a center similar to those ordinarily fitted, but furnished with a hard pyramidal point, is placed in the tail center, and forced against the end of the rotating shaft, enlarging the previously drilled hole to a suitable cone for the reception of the turning center.

Square Foot.—Has exactly four equal sides and four right angles, measuring twelve inches each way.

Square Heading.—In carpentry, a term signifying that the ends of flooring boards, when laid, simply butt squarely against each other, as at the sides.

Square Measure.—This is used in estimating surfaces according to the following:

TABLE.

144 square inches (sq. in.) make 1 square foot, sq. ft.

9 square feet make 1 square yard, sq. yd.

30 $\frac{1}{2}$ square yards make 1 square rod or perch, P.

160 square rods or perches make 1 acre, A.

640 acres make 1 square mile, Sq. Mi.

Square Miter.—An ordinary miter joint, where the abutting edges meet at an angle of 45°, thus making the external and internal edges square with each other.

Square Packing.—Gaskets made into a square sectional form. Used for packing piston rods and valve stems, also in pumps as a piston and plunger packing.

Square Point Chisel.—A wood turner's chisel having a square nose, not unlike a parting tool.

Square Root.—In mathematics, the square root of a number or quantity is that number which, multiplied by itself, produces the given number or quantity; thus 8 is the square root of 64, because 8 multiplied by 8, equals 64.

Square Thread.—In machine practice, a screw thread of rectangular section; its pitch is usually twice that of a ∇ thread for the same diameter, the thickness of each thread being equal to the width of the groove between them, while the depth is very little less than half the pitch. These threads are not employed in fastenings, but are used where it is necessary to secure accurate movement and freedom from wear, as in the various controlling parts of engines and the operating shafts and wheel spindles of machines, where nuts have to continually travel on the threads.

Square Trowel.—A moulder's finishing tool, one having a rectangular blade.

Squeegee.—A sweeping instrument, consisting of a strip of gutta percha set edgewise in a cross piece of wood at the extremity of a broom handle. The squeegee is used on shipboard for sweeping the decks clear of water and sand.

Squeeze.—To press between two bodies; to press together closely; to compress.

Squeezer.—In iron making, a machine for squeezing the puddled ball or bloom without hammering. There are two kinds, reciprocating and rotary, in both of which the impurities or cinder are squeezed out of the metal by pressure of corrugated surfaces.

Squib.—In mechanics, a detonator; in well boring, a vessel containing the explosive and fitted with a time fuse which is lowered down a well to detonate the nitroglycerin used to torpedo it.

Squinch.—In architecture, a small arch thrown across the corner of a rectangular chamber, as when a round or octagonal tower arises from a square base.

Squirrel.—In manufacturing, one of the small rollers provided with cards, and acting in conjunction with the large cylinder of a carding machine, in opening the knots and bringing the filaments into parallelism.

Squirt.—To drive or eject in a stream out of a narrow pipe or orifice; as, to *squirt* water.

Stabbing.—In masonry, the roughening of a wall in order to make stucco or plaster adhere thereto.

Stabbing Machine.—In book binding, a machine provided with three or four awls, for piercing a pile of folded and gathered *signatures*, or sheets of a printed book, making the holes for the insertion of the stitching thread.

Stability.—1. Steadiness; firmness; immovability; freedom from change or movement.

2. The stability of a vessel is not so much her immovability in a rough sea, which is rather to be termed *stiffness*, but her capacity for righting herself and assuming her normal upright position after a roll or oscillation caused by heavy seas.

Stack.—1. In mechanics, a number of funnels or chimneys standing together.

2. A single chimney or passage way for smoke.

3. The chimney of a locomotive or steam vessel.

Stacker.—A thrashing machine attachment for loading the straw on a wagon or depositing it in the form of a stack.

Stacking Derrick.—A form of derrick, used to lift hay on to a stack. It consists of an upright mast, with a swinging gaff or boom, usually swiveling completely around the mast.

Stack Stand.—A platform for supporting stacks of hay or grain, keeping them above the wet ground and free from vermin. More usually termed *staddles*.

Staddle.—1. Anything which serves for a support; a prop.

2. A small tree of any kind, especially a forest tree.

Stadium.—In architecture, a Greek measure of length equaling some 200 yards. This was the length of the Olympic races, and the term gradually became applied to the race course itself. As now employed, it means an enclosed race course, with one end open and the other closed by a circular structure, the rounded end and the sides being banked or provided with terraced seats, similar to an amphitheatre.

Staff.—1. In building, a plastic composition used instead of stone, especially when the structures are temporary; staff is composed chiefly of plaster of Paris mixed with a little cement and dextrine in water.

2. Something which supports; a prop; a stay.

3. A straight edge for truing or proving a line or surface, the *proof staff* used by millers.

4. The graduated telescopic stick used by surveyors in leveling.

Staff Head.—In building, a species of angle staff. A beaded strip of wood, placed at a vertical exterior angle in an apartment, serving to protect the plastering and as a guide in *floating*.

Stage.—1. A floor elevated for the convenience of mechanical work or the like; a scaffold; a staging.

2. A platform, often floating, serving as a kind of wharf.

Stagger.—To arrange a series of parts on each side of a median line, alternately; as, the spokes of a wheel, or the rivets in a steam boiler seam.

Staggered.—A number of similar objects, such as rivets in a seam, are said to be staggered when they are not exactly in line or opposite one another, having instead a stepped or *zigzag arrangement*.

Staging.—1. In building, a temporary support of posts and boards, or a platform slung up with ropes, etc. It is less strong than a scaffolding.

2. In civil engineering, a stout and substantial arrangement of platforms, decking, etc., supported by heavy timbers or barks. The parts are usually connected by *dogs*, to save spoiling the timber by bolt holes, which would render it unsalable upon dismantling.

Stagnant.—Still; without motion. As generally used, is the opposite of a fluid in motion.

Stain.—To color by the use of a dye or stain; said of woods, textiles, wall paper and glass; opposed to *painting*.

Stained Glass.—In architecture, glass painted on the surface with various mineral pigments which are afterwards fused and fixed by the application of intense heat.

Staircase.—In building, a flight or range of stairs or steps leading from one floor to another.

Stairs.—In carpentry, a succession of steps for persons to use in ascending or descending from one floor or level to another in a house or other building.

Staithe.—Elevated stagings or trestle bridges carrying a railway, whence coal is discharged from cars through spouts into the holds or bunkers of craft moored along side, the empty cars or wagons returning by an incline to the foot of the staithe, whence they are hauled away by locomotives.

Stake.—1. A piece of wood, usually long and slender at one end, so as to be easily driven in the ground as a support or stay.

2. A small anvil, in use among sheet metal workers.

Staking Out.—The operation of setting out boundaries, lines, etc., by means of stakes driven in the ground, generally with cords stretched from one stake to another; the process of marking out the lines for the foundations of a structure, by means of cords stretched over stakes or batten boards, which are carefully placed at each angle of the proposed excavation.

Stalactites.—Incrustations of calcium carbonate, and the like, hanging from the roofs of caverns and fissures, like icicles; these are produced by deposition from waters which have seeped through and partially dissolved the overlying limestone rocks.

Stale.—1. Deteriorated through age; having lost savor, strength or other valuable characteristics in keeping, either through evaporation of liquid or volatile constituents through internal change, or through absorption of moisture or gases from the atmosphere.

2. The stock or handle of anything; as for a rake or a hammer.

Stalk.—In founding, an iron bar with projections inserted in a core to strengthen it; a *core arbor*.

Stall.—1. A standing place, position, room or compartment.

2. A compartment for a horse in a stable.

3. A place for a locomotive in a round-house or running shed.

4. A working place in a mine.

Stall Boards.—A series of floors on which soil or ore is successively pitched in excavating; used in digging sewers, trenches, etc., in which the soil is pitched from floor to floor until it reaches the surface.

Stamp.—1. To tread on or crush under foot; to strike a sudden vertical blow with the heel.

2. Anything which impresses a figure or design by a vertical pressure or blow; as, a date stamp.

3. Anything impressed; an imprint made by stamping; as, a postage stamp.

4. A disintegrator working through the crushing force of a falling weight, as used for reducing tin and gold ores to powder.

5. Also known as *noblin*; a square block of puddled iron, as obtained by shingling under

the helve, about a foot square and from 1½ in. to 2½ in. thick. The name is also given to a rough bar weighing about 28 lbs., obtained by nicking or breaking a bloom or noblin; the pieces are broken off to ascertain the grain of the iron before piling, especially for the subsequent rolling of sheet iron.

Stamped Ware.—Hollow utensils of sheet metal, formed by dies under a stamping press; the work is effected by continuous pressure rather than by a series of blows.

Stamping.—To cut out, bend or indent, as metallic objects, formed by means of dies in either a press or a stamping machine. Some metals are worked cold; such as brass or copper; others require to be heated; wrought iron articles being made by this method, thus saving much labor at the forge. The fork of a bicycle is made in this manner from a steel sheet, undergoing treatment in twenty-seven different presses and drop hammers; spanners, knuckles, shackles and innumerable other details are *drop forged* that is, stamped out in dies under a heavy falling weight.

Stamp Mill.—In mining, a number of stamps arranged together for convenience in manipulating the products and driven from one common source of power. These stamps are heavy pestles lifted by *wipers* actuated by cams on a revolving shaft. As the cams release the stamps, they fall on the ore in a coffer or box beneath, gradually crushing it to the desired fineness, while a stream of water carries away the pulp or slimes as they are produced, through perforated openings in the side of the motor or coffer. A row of such stamps is often called a *battery*.

Stanch.—In hydraulics, a flood gate for accumulating a head of water in a river to float boats over shallows, when it is allowed to escape.

Stanchion.—An upright post or small pillar used for many purposes in a variety of forms; as, to support one of the main-parts of a roof, to support one deck from another on shipboard, or to support the horizontal rails around a ship's side.

Standage.—In mining, space allowed for water to accumulate in.

Standard.—1. A criterion or accepted measure of quality, quantity or dimensions.

2. A piece of exact and definite dimensions, employed as a test or as a basis or means of reference in workshop practice; as, a *standard gauge*, a *standard rule*.

3. An upright stand, serving as a support for machinery, generally cast from iron or steel, and provided with flanges, feet, and stiffening ribs and webs; as, the *standards* of a lathe bed.

4. A supporting part for a bearing, more especially for sustaining line shafting from the floor.

5. A pillar or post; a column acting as part of the frame of a machine or engine.

6. A scaffold pole, forming an upright member in a mason's or bricklayer's scaffolding.

Standardization.—The act of selecting the most suitable dimensions or proportions for structural or mechanical parts, thus obtaining uniformity of practice.

Standard or Measuring Rod.—In shop practice, a rod of well seasoned yellow pine used as a basis and reference for accurate measurement in a workshop. Such rods are usually made from five to ten feet long, the section of the wood being about two by two inches. Each twelve inch division is marked on a brass inlaid plate. The end foot is wholly marked on brass, accurately divided out into fractional parts as required. A standard rod is either precisely the length, if required for *butt* measurement, in which case its ends are protected with steel or brass, or the length of the rod is in excess, and the requisite length is marked on brass plates let in, from which measurement is taken with trammels, etc. Standard rods are also made with metric divisions.

Standard Piles.—In hydraulic engineering, piles placed at regular distances apart and connected by runners, as in a *cofferdam*.

Standard Rule.—A rule containing the division into ordinary inches and parts. Used to distinguish it from the *contraction rule*.

Standard Specification.—A model schedule or list of requirements, qualities, dimensions and tests, proposed to be adhered to as a basis for the manufacture of similar articles, structures or mechanisms, designed to be made in large numbers.

Standby.—1. A shop term, indicating one who, or that which, stands by one in need; something upon which one relies for constant use or in an emergency.

2. In navigation, a preparatory order, equivalent to be ready.

Standing Rigging.—In ships, the fixed ropes and chains whereby the masts and bowsprit are stayed securely. The term is used in opposition to *running rigging*, which is roved through blocks and pulled upon.

Standpipe.—1. In hot water heating, an upright pipe, having its top connected to the expansion tank to afford room for expansion.

2. A vertical pipe arrangement, often of great size, at pumping stations into which water is pumped, to give it sufficient head in the mains.

Staple.—1. Unmanufactured material; raw material.

2. A loop of iron, or a bar or wire, bent and formed with two points to be driven into wood, to hold a hook.

3. In textile manufactures, a term denoting the character of the fiber to which it is applied, more especially with regard to length; as, short stapled cotton; long stapled wool.

Starboard.—In a ship, the right hand side looking *forward*; the starboard side light is *green*, in distinction from the left hand or *port* side which has a red light.

Starch.—A white, glistening, granular or powdery substance, without taste or smell. It is used in the production of commercial *rape sugar*, in making paste, etc.

Star Drill.—A hand or machine drill for hard rock, having a point shaped like a cross or four pointed star; it is claimed to be more rapid than the chisel point pattern.

Star Gauge.—A four pointed gauge, having two adjustable and two fixed points, whereby the bore of cannons, etc., is accurately ascertained, a graduated wedge forced through a central opening, affording a micrometer measurement.

Stars and Stripes.—A popular name for the flag of the United States, which consists of thirteen horizontal stripes alternately red and white, and a union, having in a blue field white stars to represent the various states, one for each.

Start.—1. To commence; to begin to move.

2. To set in motion; to originate.

3. To jar apart by repeated strains or concussions; as, to *start* a plank or rivet.

Started.—In mining, said of a vein which is turned aside by the approach of another in its direction; when it is thrown up by approaching or intersecting another one having the same inclination, it is said to be *heaved*.

Starter.—An apparatus for giving an initial motion to a machine, especially such as may be at rest; as, a steam engine when on a dead center.

Starting.—The act or operation of commencing, setting in motion, or beginning movement.

Starting Clutch.—In a motor car, the clutch by means of which the transmission is connected with the engine, or disengaged therefrom.

Starting Crank.—The handle whereby the shaft of a motor is revolved until an explosion results and the engine starts working, also called *starting handle*.

Starting Engine.—In marine engineering, a small engine used for turning large marine engines when not under steam; as, in making repairs.

Starting Gear.—The assemblage of levers, valves and other parts whereby a prime mover is set in motion from a state of rest.

Starting Handle.—In machinery, the handle of a machine for shifting a belt from the *idler* to its power shaft.

Starting Pump.—A compressing pump fitted to gas and similar engines, by means of which a quantity of air and gas is compressed into a reservoir just before stopping; on exploding a charge of this compressed gas in the cylinder, the engine at once starts working. Certain engines are moved by a charge of compressed air alone, the ordinary cycle of explosion occurring as soon as motion takes place.

Starting Valve.—A valve, together with piping arrangements, whereby live steam is introduced above or below the low pressure or intermediate piston of a steam engine. In order to move the engine should it be stopped in a position where steam cannot enter the high pressure cylinder; also known as *impulse valve*. Another arrangement, known as a *by-pass*, admits live steam to the intermediate or L. P. steam chests, fulfilling the same purpose; these devices are usual on all multiple expansion engines.

Star Wheel.—A wheel with radial projections, either in the form of spokes, or of teeth. The former is much used on machine tools for applying or regulating the feed; the latter device is used in connection with repeating watches, meters, etc.

Star Wheel Motion.—In machinery, a feed motion employed for surfacing in lathes and boring machines, through the agency of a star wheel and suitable adjuncts. The cutting tool is carried in a slide moving in a plate, and actuated by the feed screw attached to the star wheel. The star wheel is moved one tooth at each revolution of the boring bar, by which it is carried, through the medium of a pin attached to any convenient position on the bed, or rest, or head of the machine. When the star wheel is turned through the arc represented by the passing of a tooth, the screw being also carried with it, the slides

in which the latter moves, and the cutting tool also, which is fixed in the slide, must move to the precise amount, which is regulated by the pitch of the wheel teeth, and by that of the screw thread.

State.—To represent fully in words; to narrate; to express the particulars of: to set down in detail or in gross; as: *to state the facts of a case*.

Stateroom.—A small apartment for lodging or sleeping in the cabin, or on the deck of a sailing vessel or steamer. Also, a somewhat similar apartment in a railway sleeping car.

Static Head.—In hydraulics, the height, from a given point, of a column, or body of water *at rest*, considered as causing or measuring pressure, and which is *expressed* in feet or pounds per square inch.

Static Load.—Any load at rest; as, in hydraulics the pressure on a pump piston due to *static head*.

Statics.—In mechanics, the science of bodies at rest, opposed to *dynamics*; statics treats of forces that keep bodies at rest, or in *equilibrium*; acting, as weight but not moving.

Station.—The spot or place where anything stands; the place where railroad trains regularly stop for the convenience of passengers, taking in fuel, discharging freight, and the like.

Stationary.—Not moving; not appearing to move; stable, fixed.

Stationary Engine.—A steam engine is stationary when it is mounted and fixed in a permanent form.

Station House.—The house serving for the headquarters of the police, assigned to a certain district, and as a place of temporary confinement.

Statistics.—Detailed information, respecting any particular class or interest, especially those subjects which can be stated in numbers, or in tables of numbers, or in any tabular and classified arrangement.

Statute Mile.—The customary land mile of England and the United States: it measures 80 chains, 1760 yards or 5280 feet, and is 0.868421 of a nautical mile. A knot or sea mile is 6080 feet, and is equal to 1.151515 statute miles. A kilometre is 0.6213824 statute miles, or a land mile is equal to 1.609315 kilometres.

Statutory.—As ordained or required by statute or legislative enactment of a state or nation; complying with the legal requirements of a country, or community.

Staunch.—In boiler making, riveted joints are rendered *staunch* or water tight by caulking. Plates bolted together are rendered staunch by caulking with iron borings and sal ammoniac. See also *stanch*.

Stave.—One of the shaped pieces of wood which are bound together with hoops to form a cask, tub, etc.

Stave Jointer.—A device or machine tool for truing the edges of barrel staves.

Stay.—1. To linger, or remain.

2. To cause to stop, to detain, to prevent.

3. To strengthen, so as to prevent damage or deformation.

4. A prop or support to strengthen or stiffen a structure; as generally used, the term denotes a strengthening part under a tensile stress, preventing the remainder from being torn apart; as, the *stays* of a boiler.

5. A large, strong rope, employed to support a mast, by being extended from the head of one mast down to some other, or to some part of the vessel. Those which lead forward are called fore and aft stays; those which lead to the vessel's side, back stays.

Stay Bolt.—1. A rod connecting opposite plates so as to prevent them from being bulged out.

2. One of the screwed stays uniting the inner and outer fire boxes of a locomotive; known in England as a *fire box stay*. The American practice is to use high quality wrought iron, English practice calls for copper, while many railways use a special bronze. In view of the numerous failures of these important stays, various devices to insure flexibility are in use. To give warning of fracture, it is also customary to drill telltale holes axially into the stay, when a break will be indicated by issuing steam or water.

Stay Bolt Iron.—A specially selected wrought iron bar suitable for stay bolts. Some authorities prefer the finest and softest iron; some locomotive works specify a tensile strength of 50000 to 52000 lbs., giving an iron just soft enough to heat up.

Stay Ends.—These are braces made of angle or T iron, placed across the ends of steam boilers. By this arrangement the stays can be placed further apart, the angle irons very effectively staying the plate between the stays and thus affording more room in the body of the boiler.

Staying.—Two natural shapes are capable of withstanding pressure by themselves, the *sphere* and the *cylinder*. All flat surfaces, or those not sufficiently curved to form parts of a sphere or cylinder, must be stayed from each other, the bursting pressure in this case being transferred from the shell plates to the stays, which must be so proportioned as to support the surfaces without risk of deformation as well as to prevent rupture.

Stay Pile.—A pile adjacent to a *main pile* so placed as to be a support to the latter.

Stay Tube.—A boiler tube, stouter than the others, which is threaded at either end and screwed through both tube plates to brace them together. The ends are either beaded over, or else secured with lock nuts. The threads are usually *plus and minus*; that is, the thread at the front is larger than the outside diameter of the tube, while that at the back is the same diameter as the tube.

Stead.—Anything *standing*. The word is commonly used as the last part of a compound; as, *homestead*, *roadstead*, *bedstead*.

Steadfast.—Firmly fixed or established; firm.

Steady.—1. Regular, constant, uniform; as, a *steady breeze* of wind.

2. To make steady; to hold or keep from shaking or falling; to support.

3. A shop term for a *lathe steady rest*.

Steady Pin.—In mechanics, a tightly fitting pin or dowel, used to hold one part exactly true with another; as, a cylinder on its columns, or the cope of a founder's flask on its nowel.

Steady Rest.—A support in a lathe for long flexible objects, preventing them from springing under the cut of the tool. It is generally made as some form of adjustable bearing, in which the work revolves.

Steam.—The vapor of water; the hot invisible vapor given off by water at its boiling point, this latter depending upon the pressure. The visible white vapor termed steam, is really a collection of fine watery particles, formed by condensation of true steam. When water is evaporated within a closed space, the process will continue up to a certain point, when the steam is said to be *saturated*, this signifying that no more steam can be made, unless the temperature be raised or the pressure lowered, by permitting some of the steam to escape.

The distinguishing properties of steam are: (1) Its fluidity, (2) its mobility, (3) its elasticity, and (4) its equality of pressure in every direction; that is, steam has a flow like water, it has a circulation within its own body, it is capable of compression and expansion, and

when it is confined it presses equally upon all parts of the restraining vessel. Each molecule of steam is composed of two gases which have neither taste nor color. The difference in volume between water and steam at atmospheric pressure is as 1646 to 1; that is, a given quantity of water expanded into steam will occupy 1646 times the space it did before. This is nearly one cubic foot, and one cubic foot of steam at atmospheric pressure weighs .038 lbs.

Steam is said to be: (1) *saturated* when its temperature corresponds to its pressure, (2) *superheated* when its temperature is above that due to its pressure, (3) *gaseous steam* or *steam gas* when it is highly superheated, (4) *dry* when it contains no moisture. It may be either saturated or superheated, (5) *wet* when it contains intermingled mist or spray, its temperature corresponding to its pressure.

Steam Blast.—In a locomotive, a forced draught created by discharging the exhaust steam through a conical pipe up the chimney, sucking the flame and gases through the tubes, and fresh air through the fire, thus increasing the rate of combustion.

Steamboat.—A boat, especially one of large size, propelled through the water by steam. Also called *steamer*.

Steam Boiler.—An apparatus for generating and retaining steam. The most common types of steam boilers may be arranged under the following designations: (1) The plain cylinder boiler, (2) the cylinder flue boiler, (3) the cylinder tubular boiler, (4) the return flue boiler, (5) the return tubular boiler, (6) water tube boiler, (7) the locomotive boiler, (8) the sectional boiler.

The primary conditions which steam boilers should fulfill are: (1) strength to sustain the internal pressures to which they may be subjected, (2) durability, (3) economy or efficiency in evaporating qualities, (4) economy of construction in materials and workmanship, (5) adaptation to the particular circumstances of their use, (6) to these conditions must be added safety, which depends on form, construction, strength and quality of materials, as well as management.

Steam Boiler Inspection.—A periodical examination of boilers by expert and experienced engineers, or by government officials or the agents of steam boiler inspection companies, to assure the strength and safety of the structure. From the moment a steam boiler is constructed there are numerous insidious agents at work which tend to weaken it. There is nothing from which the iron can draw sustenance to replace its losses. The atmosphere without and the air within the boiler, the water as it enters through the feed pipe and containing mineral and organic substances, steam into which the water is converted, the sediment which is precipitated by boiling the water, the fire and the sulphurous and other acids of the fuel, are all natural enemies of the steel or iron; they sap its strength, not only while the boiler is at work and undergoing constant strain, but in the morning before fire is started, and at noon, night, Sundays, and other holidays.

Steam Boiler Inspector.—An official

who surveys and inspects boilers, either with a view to insurance or to satisfy the proper authorities that legal requirements have been complied with. In most civilized countries, large insurance corporations inspect boilers annually or more often if required, so that the owner receives the best technical advice as to maintenance and repair, besides being insured against mishap.

Steam Brake.—In a locomotive, a brake fitted to the driving wheels, applied by means of a steam cylinder acting through levers.

Steam Chamber.—A vessel or compartment above the water from which steam is conducted to the engine; also called *steam dome*.

Steam Chest.—1. In an engine, the box from which steam is distributed to a cylinder, and which usually contains one or more valves; called also *valve chest* and *valve box*.

2. In calico printing, a vessel in which so called steam colors are exposed to steam, to fix them in the fabric.

Steam Chest Balance Plate.—A cast iron plate or partition within the steam chest, against which press the balancing strips or rings on the back of the slide valve, thus excluding pressure from an area which is said to be balanced.

Steam Coal.—Coal, which by experiment, has been found well adapted for the purpose of making steam.

Steam Cock.—A cock fitted in a steam pipe to control its opening or closing.

Steam Condensation.—A change from the gaseous state of steam into water.

Steam Dome.—A chamber upon the top of the boiler in which steam is collected for supplying the engine.

Steam Draught.—A draught in a furnace produced by steam. In the locomotive this is effected by conducting the exhaust steam through pipes from the cylinders to the smoke box, and allowing it to escape up the smoke stack, from apertures called exhaust nozzles; the velocity of the steam produces a vacuum, by which the products of combustion are drawn into the smoke box with great power and forced out of the smoke stack into the open air.

To prevent the too quick passage of the gases into the flues, an appliance called a *fire brick arch* has been adopted and has proved very efficient. In order to be self supporting, it is built in the form of an arch, supported by the two sides of the fire box which serve for abutments. The arch has been sometimes replaced

by a hollow riveted arrangement called a *water bridge*, designed to increase the fire surface of the boiler.

Steam Drill.—A rock drilling machine, in which the boring bar is actuated by a steam piston.

Steam Engine.—An apparatus for doing work by means of heat applied to water; an engine moved by steam.

Steam Engine Cylinder.—A closed vessel in which the piston works backward and forward. It is so called because the interior is cylindrical in shape.

Steam Engine Indicator.—The indicator, as adapted for use with steam-engines, having a piston of half a square inch in area. A gas engine indicator, to avoid unduly heavy springs, has a piston only one quarter of a square inch in area. Ammonia indicators are made wholly of steel or a white metal which will resist the ammonia, as this corrodes brass.

Steam Expansion.—Steam admitted to a cylinder during a portion of the stroke, then cut off, and expanded in the cylinder, upon the piston, for the remainder of the stroke.

If the flow of steam to an engine be cut off when the piston has made half its stroke, that is, if it is used expansively, it has been ascertained that the efficiency will be increased one and sixty-nine hundredths times beyond what it would have been, if the steam at half stroke had been released into the atmosphere, and so on, as expressed in the following (approximate)

TABLE.

Cutting off at $\frac{1}{10}$ the stroke,	efficiency is increased 3.3 times.
Cutting off at $\frac{1}{8}$ the stroke,	efficiency is increased 3 times.
Cutting off at $\frac{1}{6}$ the stroke,	efficiency is increased 2.6 times.
Cutting off at $\frac{1}{4}$ the stroke,	efficiency is increased 2.386 times.
Cutting off at $\frac{1}{3}$ the stroke,	efficiency is increased 2.2 times.
Cutting off at $\frac{1}{2}$ the stroke,	efficiency is increased 1.08 times.
Cutting off at $\frac{2}{3}$ the stroke,	efficiency is increased 1.02 times.
Cutting off at $\frac{3}{4}$ the stroke,	efficiency is increased 1.69 times.
Cutting off at $\frac{4}{5}$ the stroke,	efficiency is increased 1.5 times.
Cutting off at $\frac{5}{6}$ the stroke,	efficiency is increased 1.47 times.
Cutting off at $\frac{7}{8}$ the stroke,	efficiency is increased 1.35 times.
Cutting off at $\frac{9}{10}$ the stroke,	efficiency is increased 1.28 times.

The theoretical values given in the above table are largely reduced in practice, chiefly by condensation which increases with the expansion ratio. On this account it is not advisable to expand steam more than four or five times in one cylinder non-condensing, nor more than six or seven times condensing. Tests have shown that the efficiency is not increased by exceeding

these limits. For higher expansions additional cylinders are used, thus dividing the temperature range and reducing the total condensation.

Steam Fire Engine.—A steam pump, usually of the fly wheel pattern with two or three cylinders, mounted on a four wheeled vehicle which also carries a tubular or coil boiler to generate the necessary steam. The whole apparatus is designed for rapid and intense production of steam, and the delivery of the powerful jets of water necessary for fire extinguishing purposes; care being also taken to keep down weight and make the whole sufficiently substantial to withstand shocks.

Steam Fitter.—A workman who installs piping and fittings for steam heating, etc.

Steam Gauge.—An instrument for indicating the pressure of steam in a boiler. A common form, especially for high pressures, consists of a spring pressed upon by the steam and connected with the pointer of a dial. The spring may be a flattened bent tube, closed at one end, which the entering steam tends to straighten, or a corrugated vessel of elastic metal.

Steam Generator.—A term applied to a type of boiler made up of a series of coils or units of steel tubing. It is used chiefly in automobiles and rapidly generates superheated steam of a very high pressure. Also called *flash boiler*.

Steam Hammer.—A forge hammer consisting of a steam cylinder placed vertically over an anvil, the trip or hammer head rising and falling by the power of steam.

Steam Heating.—1. The operations whereby buildings are heated by means of steam, circulating through pipes, coils and radiators; live steam both high and low pressure, exhaust steam, and low pressure steam under a vacuum being employed.

2. The devices and apparatus whereby this method of heating is carried out.

Steaming.—1. The act, process, or operation of doing anything by the aid of steam.

2. Subjecting to the action of steam with a view to softening, macerating or impregnating, as in the arts; the operations being usually carried on within a closed vessel under a moderate pressure.

3. Actual motion by the aid of steam; as, transit of a steamship from port to port.

Steam Jacket.—1. An annular space, formed in the walls of a vessel, or chamber, whereby the contents may be heated by steam without actual contact.

2. In the steam engine, the object of the jacket around the cylinder is to maintain a constant temperature equal to that of the inflowing steam, with a view to prevent condensation.

Steam Jet.—A blast of steam issuing from a conical nozzle.

Steam Joint.—In steam and pipe fitting, the joints made between the various flanges of steam pipes and steam connections, as cylinder covers, steam chests, stuffing boxes, etc. Yarn, copper wire, india rubber, lead, millboard, and other substances are used in the making of steam joints.

Steam Lap.—Lap on the admission or steam side of a slide valve, whereby an earlier cut off and consequent expansion is produced.

Steam Launch.—In navigation, a large man-of-war's boat with a propeller engine; a pleasure craft, with steam propulsion.

Steam Loop.—An arrangement of piping, resembling a double syphon, by which water of condensation is returned to a steam boiler. It is necessary that the *drop leg*, or return pipe be sufficiently high for the weight of water therein to overcome the difference between the boiler pressure and that in the apparatus. The *horizontal pipe*, corresponding to the bend of the syphon, must also slightly condense the steam, occasioning a fall in temperature at the head of the loop. This condensation causes a slight reduction in pressure which draws up the exhaust steam and the condensed water from the heating system, the latter traveling up the *rise pipe*, intermittently, in the form of *slugs*. As the water accumulates in the drop leg, its weight forces it past the check valve into the boiler.

Steam Nozzle.—The discharge opening of a steam blast pipe, narrowed to increase the force of the jet. Applied to the blast pipes of steam engines, and to the pipes by which steam is discharged into chimneys and furnaces to increase the rate of combustion.

Steam Passages.—The steam and exhaust ports of an engine cylinder through which the steam obtains ingress and egress. They should bear constant proportion to the size of the cylinder and the rate of travel of the piston, together with ample allowance for loss of friction due to bends in the pipes, their size being such that there should not be any material difference in the pressure of steam in the cylinder and in the passages. An excess of size should always be given them. The ports are usually proportioned so that the velocity of steam will be 8000 ft. per minute through the steam ports and 4000 ft. per minute through the exhaust port, the calculations being based on steam velocities *before* expansion.

Steam Pipe.—1. A pipe used to convey live steam from a boiler to an engine.
2. The internal collecting pipe in a

locomotive boiler, known otherwise as the *dry pipe*.

3. One of the bent cast iron or copper pipes, within a locomotive smoke box, conducting steam from the tee or niggerhead at the extremity of the dry pipe to either cylinder. The joints on the tee are usually ball and socket or else expansion joints, to permit a little motion due to expansion or contraction, or to allow for adjustability in fitting.

Steam Plow.—A gang plow, operated by means of a wire rope which is either wound from one to another of two engines at opposite sides of the field, or is worked on an endless system from one engine alone, the bight of the wire passing around an anchor at the far end of the field.

Steam Port.—An opening in the valve face through which steam is admitted to the cylinder; the whole of the steam passage is often spoken of as the port.

Steam Pressure.—The stress or strain set on boilers, pipes, etc., by the steam, expressed in terms of atmospheres, kilogrammes per square centimetre, or pounds per square inch. Pressure is caused by the incessant bombardment of the containing surfaces, by the innumerable molecules of vapor darting continually about in all directions. The more heat is applied, the more steam is generated, consequently all these particles become more compressed or congested and restricted in their movements, so increase of pressure results.

Steam Pressure Recording Gauge.—An instrument for ascertaining and recording the pressure of steam. It has a dial on which the hand marks, in pencil, the pressure of steam, so as to leave a record of the varying pressure carried during the working hours by a steam boiler.

Steam Pump.—A pump driven directly by a steam engine on the same bed. The pump and steam pistons are generally on the same rod whether the motion be of the familiar duplex type or if there be a crank and fly wheel to secure more uniform effort and permit expansion of the steam.

Steam Roller.—A locomotive steam engine, traveling upon common roads, whose wheels are replaced by heavy iron cylinders, with the object of consolidating the materials of which such road is formed.

Steam Room.—The space above the water in a steam boiler.

Steam Separator.—A T shaped pipe in which the steam is led down under a diaphragm plate and then up again into the steam pipe. By this means any priming or entrained watery particles will fall to the bottom, whence it may be blown out. Baffles and gratings are also fitted, to riddle out the water, and a gauge glass or steam trap is generally fitted to the receiver at the bottom of the tee. Also known as *interceptor* or *catch-water*.

Steam Shear.—A shearing machine for metals, of large size, actuated by its own independent steam cylinder. Such machines are common in shipyards and the like.

Steamship.—A vessel propelled by steam power.

Steam Shovel.—A machine operated by steam, fitted especially to excavate gravel, sand and rock.

Steam Steering.—Directing or controlling the motions of a vessel by means of a steam engine, which moves the rudder into the required positions. The helmsman operates a small wheel on the bridge or in a wheel house forward, and has simply to move a valve on the steam steering engine, which latter, through the intervention of a hunting gear, exactly follows the motions of the small wheel, imparting them to the tiller.

Steam Table.—1. A hollow table heated by steam, to keep joints and other viands warm in the dining or carving rooms of hotels.

2. A tabulated sheet giving the properties of steam at different pressures, such as temperature, latent and total heat, weight per cubic foot, etc.

Steam Tank.—A chamber heated by steam, used for various purposes in the arts, such as steaming wood, paper stock, rendering fats, etc.

Steam Tight.—In steam engineering, flanges, moving rods, pistons and other jointed portions are rendered *steam tight* by various modes of packing.

Steam Trap.—A contrivance to allow the passage of water and prevent the passage of steam, used to free piping from water of condensation.

Steam Tug.—A small but powerful steam vessel for towing ships and other craft in or out or about a harbor. A *sea going tug* is one designed to withstand heavy weather, liable to be met with in the open sea. The latter type is also called *tow boat*.

Steam Turbine.—A motor in which rotary motion is obtained by the action of steam impinging upon blades or vanes set upon the circumference of a drum or ring, which works within a suitable casing. Steam turbines may be classified as *reaction* or *impulse*.

Steam Users.—Term applied to the proprietors and owners of a steam plant.

Steam Whistle.—An apparatus attached to a steam engine or locomotive through which steam is rapidly discharged, producing a loud, shrill sound, which serves as a warning or signal. The steam issues from a narrow annular orifice around the upper edge of the lower cup or hemisphere, striking the thin edge of the bell above it, and producing sound in the manner of a common whistle.

Steam Winch.—A steam engine combined with a winch for the purpose of raising weights.

Stearine.—An important fat, forming the bulk of beef and mutton suet, therefore of tallow. It may be regarded as a compound of glycerine with stearic acid, and is a white crystalline fat largely used in making the fatty acids required in candle making. Also spelled *stearin*.

Steel.—A compound of iron containing 0.25 to 3% of carbon, usually with small quantities of silicon and manganese. The carbon causes it to harden when cooled suddenly from a red heat, and to soften again when cooled slowly. Steel classed as mild or ingot steel, is so made by a fusion process, which frees it from intermingled slag.

The more highly carbonized varieties, such as *crucible* and *shear steel* are used for tools, weapons and springs, their properties of hardening and tempering being invaluable. Modern research has led to the employment of less highly carbonized or mild steels in a variety of forms, either as castings or as forgings or rolled sections, thus displacing cast and wrought iron. Other metals, such as chromium and nickel are mixed with steel, increasing its tenacity and toughness to a remarkable extent. *Bessemer steel*, *open hearth process*, *mild steel*, *nickel steel*, etc., are varieties.

Steel Belt Lacing.—A name given to a belt fastener chiefly used in connection with cotton or other fabric belts. It is a small harrow like plate of metal, whose tines are forced through the belt from the outside and clinched over at the back.

Steel Bronze.—A very hard and tenacious alloy used as a substitute for steel. Its composition varies but little from that of the usual gun metal, 90% copper, 10% tin.

Steeling.—In ornamental iron work, the facing of wrought iron work with a thin layer of steel, in order to impart durability, or cutting power thereto.

Steel Mill.—An establishment for making and rolling out steel.

Steel Press.—A machine for compressing molten steel in casting, to improve the quality of the product.

Steel Rule.—A machinist's tool. Machinist's rules are made of steel, usually a foot long, and containing numerous subdivisions of the inch, ranging from eighths to sixty-fourths.

Steel Square.—An instrument, usually made of flat steel about $\frac{1}{2}$ in. thick, with two unequal arms, the longer or *blade* being 24" x 2", the shorter or *tongue* being 18" or 18" x 1 $\frac{1}{2}$ ". Not only is it serviceable as a rule or a square to mark off right angles, but the graduations are so arranged, that by one reading of the outer edge both measurements for a brace can be taken, and similarly, by means of the marking on the inner edge, the width and thickness of a plank can be taken at one reading. Other graduations permit the measurement of superficies; the square constitutes a simple calculating machine for solving many problems involving right angles, etc.

Steel Warrant.—A purchaser's warrant or title to a certain quantity of steel, supposed to be manufactured and in storage; corresponding to the receipt given a farmer by the elevator company for his grain.

Steel Wire.—Wire made of steel in all grades and tempered for springs, drills, etc.

Steel Works.—A factory where steel is made from the raw materials and manufactured into useful articles or forms: the term is more usually employed to designate a works where Bessemer or open hearth steel is made on a large scale rather than a place where carbon steel is produced and made into edge tools, cutlery, etc.

Steelyard.—1. A weighing apparatus, consisting of a beam or lever with two unequal arms, so that an adjustable or sliding weight on the longer graduated arm, can balance a much greater weight suspended from the shorter arm. Upon the principle of the steelyard are built up the weighing machines in use everywhere.

2. A portable *spring balance* used by itinerant vendors in place of the older steelyard.

Steening.—In masonry, a well wall half a brick thick.

Steep.—1. Sheer or precipitous, having a slope approaching the perpendicular; difficult of ascent; as, a *steep* gradient.

2. To immerse in a liquid; to soak; to macerate.

Steeple.—A general term applied to any lofty structure which is part of a public building, whether it be a simple tower or a tower surmounted, as is usual, by a spire.

Steeple Engine.—1. A steam engine erected in an upright form, having the connecting rod working in a steeple shaped structure; an adaptation of the return connecting rod engine to *paddle wheel steamships*.

2. A vertical compound engine, having one cylinder above the other and both pistons connected to one rod.

Steeple Jack.—One who repairs towers, spires and high chimneys, a work requiring daring and nerve and a certain acrobatic dexterity. Ascending the first ladder, the steeple jack drives a holdfast or dog into a masonry joint as far above him as possible: this dog bears a small pulley, by whose aid the next ladder is pulled up. Each ladder is so made that the feet of one fit into sockets on the head of the one immediately below it. As soon as the second ladder is secured and lashed, the steeple jack climbs it and drives the holdfast for the third, so continuing until the ascent is made. Stages are built or are manoeuvred from pulleys fixed at the top, so that all sides of the spire or chimney may be painted or otherwise repaired.

Steer.—In navigation, to control a vessel's course by means of the rudder.

Steering Engine.—In navigation, a steam engine, controlled by the helmsman, which actuates the rudder.

Steering Gear.—The arrangement or assemblage of parts and connections whereby motion is communicated as desired to the tiller or rudder head of a vessel, or to the jointed parts of the front axle of a motor car, in each case resulting in the steering of the vessel or the car.

Steering Pillar.—In a motor car, the tubular post which supports the steering lever or wheel.

Steering Pivot.—Either jointed end of the front axle of a motor car, carrying a wheel, and through which the steering gear works.

Steering Rod.—In a motor car, the rod which connects the steering gear, worked by wheel or tiller, with the bell cranks or steering pivot arms, by means of which the vehicle is steered.

Steering Wheel.—In navigation, the spoked wheel by which a helmsman controls the rudder and guides the ship on her course.

Stem.—1. The central pin or spigot of a mushroom valve, which works within a hole in the perforated seat, constituting the guide for the valve.

2. A rod working through the stuffing box of a slide valve casing, one end being connected to the valve by means of a nut or yoke, the other end being jointed to the valve gearing; what is usually known as a *valve spindle*.

Stemmer.—In mining, a copper or bronze rod inserted into a powder charge, so as to leave a passage through the tamping for the fuse; a *blasting needle*.

Stemming.—1. In mining, the stuff tamped down upon a charge of powder.

2. In carpentry, the act or process of cutting out with a chisel and mallet; as, a mortise, etc.

Stemple.—In mining, a crossbar of wood placed in the shaft serving as a *step*; spelled also *stempel*.

Stem Winding.—A watch in which the stem or pendant may be used as a key while winding, by pushing it into contact with a winding wheel and turning. The *keyless* watch, as it is called, avoids the trouble of carrying a watchkey, and is free from the access of dust to the works.

Stencil.—A thin sheet usually of metal, perforated to form a pattern, through which paint may be rubbed on the exposed surface by the aid of a stiff brush. Stencils cut with different letters are made to lock into one another, so that they can be arranged to spell any desired word, thus lessening the labor when a number of packages require to be marked with the same name.

Stenciling.—The art or process of marking by means of a stencil. Decorations on walls and ceilings, borders, etc., are frequently put in by this method, and addressing or marking packages is almost always done by it.

Stencil Plate.—1. A stencil made of metal, as apart from one of card or other material.

2. A stencil consisting of a complete design or name on one plate.

Step.—1. A support for the foot, serving as one of a flight of stairs, or to assist in getting into a vehicle, to enable an attendant on machinery to reach parts inaccessible from the platform, and similar purposes.

2. In carpentry, the foot piece of a timber, in which the foot of a principal rafter is *slipped* into a tie beam.

3. In mechanics, the socket for the lower pivot of a spindle or vertical shaft; the *lower brass* of a journal brass or pillow block.

Step Bearing.—In millwrighting, a contraction of *foot step bearing*; one which supports the bottom of a vertical shaft, or that of a spindle of a millstone.

Step Box.—In millwrighting, a case for the bearing surface at the lower end of a vertical spindle or shaft.

Stephenson, George.—Born 1781; died 1848. An English engineer and inventor, sometimes called the "father of railways." At first he engaged as mining engineer, and devised a safety lamp simultaneously with Davy. In 1814 he constructed his first locomotive which operated successfully; the next year he built another which was a decided improvement; he laid a railway to a colliery (1819-22); became a railway engineer (1824-26), constructing a successful road and using his own locomotives; he won the prize in a public competition with his famous engine the "Rocket," which was provided with a tubular boiler and other vital improvements (1829); thereafter he was constantly engaged in projecting and building railways, being easily the leading engineer in England. He was the first president of the Institute of Mechanical Engineers (1847), and with characteristic modesty declined the knighthood offered him by the Queen.

Stephenson Link.—In a steam engine, a reversing gear in which the ends of the two eccentric rods are connected by a curved link or quadrant sliding over a block at the end of the valve spindle, thus making provision for forward or backward motion, and for expansion by earlier cut off at intermediate positions.

Stepladder.—Portable steps, having flat treads and usually a hinged frame at the back, constituting legs which render the structure self supporting. Called also a *pair of steps* or *set of steps*.

Step of Screw.—The distance between two adjacent threads, more commonly termed the *pitch* of the screw.

Stepped Pulley.—A pulley of differing diameters, forming in conjunction with another corresponding one, the means for driving a machine by a belt at varying speeds. Although the diameters vary abruptly, forming steps, the pulley is generally known as a *speed cone*.

Stepping Round.—In pattern making, this term is often used to signify the dividing round of the rim of a toothed

wheel pattern into equal parts, according to the number of teeth required. It is done with spring dividers by a process of *trial and error*.

Step Vein.—In mining, a vein of metaliferous mineral, filling a fissure which is shaped like a flight of steps, with alternating horizontal and nearly vertical portions.

Stereobate.—In architecture, a base; the lower part or basement of a building or column. A *stylobate*.

Stereometry.—The art or process of measuring the contents or volume of solid figures and bodies.

Stereoscope.—An optical instrument, used to illustrate the phenomena of binocular vision where, for example, two objects or views, photographed at a certain angle, *appear as one*.

Stereotype.—In printing, the process of reproducing a page of type by means of a metal cast, which is used instead, so that the same edition of a newspaper may be printed simultaneously on several presses, also avoiding the heavy wear on the type. A *flog* or pad of papier maché, consisting of alternate sheets of tissue and blotting papers with composition between, is placed in its plastic state on the face of the form of type, and beaten on the back with a stiff brush, until an impression of the printing surface is obtained. The *matrix* thus formed, is hardened by steam heat in a press, being kept perfectly flat for a cylinder or platen machine, or bent to the proper curvature for a rotary press. The mould is ready in about fifteen minutes, is dusted with French chalk and placed in a casting box, whose lid forms the back of the mould. The metal is poured with the box on edge, and soon sets, the plate being taken out, trimmed, and then planed or bored to a uniform thickness on the back. Several plates may be obtained from one matrix.

Sterling.—A standard of high quality and genuine worth. At a period in English history when the coinage was very debased, moneys issued by the merchants of the Hanse cities or *Easterlings* was held at a premium on account of its purity and just weight. Since then the term *sterling* has become the synonym for guaranteed good money.

Stern.—The after or rear end of a ship.

Stern Bush.—The outermost bearing in the stern tube, generally of lignum vitae.

Stern Frame.—The cast or forged steel frame combining in one, sternpost, rudder post and propeller opening, which forms the aftermost perpendicular member of a steam vessel's structure.

Stern Gland.—The packed gland around the propeller shaft at the inboard end of the stern tube.

Stern Light.—A white light shining due aft, while a ship is underway, to warn overtaking vessels.

Stern Seats.—Those seats in a small boat, between the after thwart and the stern; the place of honor where officers or passengers are carried.

Stern Tube.—A tube of steel or bronze enclosing the propeller shaft, and provided with bushings at either end, and a stuffing box and gland inboard; one end is firmly attached to the sternpost, which is bored out to receive it, and the other is fastened to the afterpeak bulkhead.

Stern Wheel.—A single wide paddle wheel placed across a vessel's stern, instead of one on either side amidships. This type of wheel, much used for shallow river navigation, is driven by horizontal engines through a crank on either end of the paddle shaft, the boilers being frequently placed far forward to balance the weight of machinery at the stern. A rudder is placed on either quarter, the two being connected by a drag link. The stern wheel steamer is notoriously a bad steerer, and so is being gradually displaced by tunnel screw steamers, which have the propeller running in an inboard tube, this device rendering it possible to work a five foot diameter propeller while the ship only draws three feet of water.

Stern Wheel Steamboat.—A type of river steamer propelled by a paddle wheel situated at the stern of the ship.

Stethoscope.—A tube fitted at one end with a microphone or telephone receiver by which waterworks inspectors are able to listen at *night*, to the flow of water through the mains, thus being able to detect waste or leakage. The use of the stethoscope is naturally accompanied by closing out various streets so that the passage of water can point accurately to the thoroughfare along which undue consumption or leakage occurs.

Stevodore.—In navigation, one who stows or packs away goods within the hold of a ship; a loader or unloader of vessels.

Stevens, John.—Born 1749, died 1838. An American engineer and steamboat builder. After considerable experimenting, he built a screw steamer (1804), patenting his design of boiler, and the next year he introduced twin screws, but failed to acquire much speed thereby; in 1811 he established the first steam ferry in the world, between New York and Hoboken; he designed the double hull ferryboat (1813); obtained the first charter for a railroad in the United States (18'5), though the road was never built; and in 1826 he built the first railroad locomotive from his own designs.

Stevens, Robert Livingston.—Born 1787, died 1856. An American marine and railroad engineer, son of John Stevens. He built the steamboat "Philadelphia" (1815); he designed the present type of ferryboat and many important engine details and improvements; he built the "North America" (1827), the largest steamboat up to that time which attained a speed of fifteen miles an hour; in 1830, while president of the Camden and Amboy R. R., he designed the T rail, locomotive pilot, bogie truck, vestibule cars, etc.; when he died he was engaged in building an iron-clad for the U. S. Government which was never completed.

Steward.—A fiscal agent of certain bodies; as, a steward on a construction of a building, representing his trade union for that job and notifying his walking delegate regarding matters of interest to his union on that particular job.

Stibium.—In chemistry, a name for *antimony ore*. Its abbreviation *Sb.* is used in chemistry as the symbol for metallic antimony.

Stick.—1. A piece of wood of indefinite size, long as compared with its diameter or cross section.

2. Anything shaped like a stick; as sealing wax, crayons, etc.

3. The instrument in which a compositor sets type together so as to form words, and the words are spaced out to the proper length of the line.

Sticker.—A wood working machine, used on articles of small cross sectional area, such as picture frame moulding, etc.

Sticking Machine.—A woodworking machine, forming straight mouldings by means of rotary cutters.

Sticking of Valves.—A term used in steam engineering. The sticking of safety valves is a fruitful cause of boiler explosions, and is due to several causes. Bending of the spindle, corrosion, and bad design are the chief ones.

Stiff.—Not easily bent; not flexible or pliant; but rigid, firm; as, *stiff* wood.

Stiffening.—Something used to make anything stiff.

Stiff Leg Derrick.—In rigging, an implement for hoisting or lowering heavy loads, consisting of a mast which is supported by two or three wooden or iron braces to hold it in position.

Stile.—1. A step or series of steps on each side of a fence or wall, to aid in surmounting it.

2. In carpentry, one of the upright side pieces in a door or sash; a fence post that receives a cross bar.

Still.—1. Motionless; at rest; quiet; as, to stand *still*.

2. A vessel in which some liquid or semi-solid is submitted to distillation; that is, its more volatile constituents are evaporated and led to another vessel in which they are condensed.

Still House.—An establishment where distillation is carried on; a distillery.

Stillson Wrench.—A variety of monkey wrench having serrated jaws to enable it to grip a pipe or round surface, thus fitting it to act as both *pipe tongs* and *spanner*.

Stilt.—1. One of a pair of slender poles, having a projection above the lower end to support the foot above the ground in walking.

2. A pile driven to support a bridge pier.

3. A prism or tripod of refractory clay used in pottery manufacture as a support in the kiln.

Stint.—In shop practice, to assign a certain (i. e., a limited) task to a person, upon the performance of which he is excused from further labor for the day or for a certain time; to *stint*.

Stipulation.—That which is agreed upon; that which is definitely arranged or contracted; a contract or bargain; an engagement.

Stirrer.—A mechanical device to keep a solution from settling; as, the stirrer for color pans in a calico printing works.

Stirrup.—1. In mechanics, a loop or bent strap bent around one object and secured to another by various means, to support the former.

2. The iron loop, clevis or shackle, suspending a mill or gang saw from the sash in which it is strung.

3. An iron strap to support a beam.

4. A strap or loop supporting a rod spindle or similar object, in a vertical direction. The spindles of certain sensitive drills are supported by *stirrups* which embrace the spindle head.

Stirrup Iron.—A sort of hanging bracket forming a recess or stirrup into which the end of a cross beam might fit, thus obviating the need of notching the latter.

Stitch.—A pass of a needle in sewing; the mode of making the stitch and the kind of stitch characterize the various sewing machines.

Stitching Clamp.—A work holder much used by saddlers and harness makers, and by others stitching stiff material. *A stitching horse.*

Stock.—1. An accumulation of similar commodities in one place.

2. Articles manufactured, for economic reasons, in large quantities to standard sizes and patterns, and held in storage to meet the fluctuations of public demand.

3. Domestic animals, usually neat cattle. The animals on a farm are termed *live stock*; the instruments of husbandry, *dead stock*.

4. Rough material destined to be wrought into finished articles.

5. A handle for any appliance; the term is usually restricted in its employment.

6. That part of a firearm forming the foundation to which the barrel and lock are attached, and which is held against the shoulder in firing.

7. The block part of a carpenter's plane, into which the plane iron is fixed.

8. The cross bar in the shank of an old fashioned anchor, which cants it on the bottom and turns a fluke down to grip in the ground.

9. The handle or frame in which a screw cutting die is fixed.

10. In blacksmithing, the mass of hard, melted, caked coal, which surrounds the hollow incandescent portion of a smith's fire, and within which the heat is localized at pleasure, and from which the fire is fed.

Stock and Dies.—A hand screwing apparatus, consisting of a frame into which are inserted the dies for forming a desired male thread; the frame has a long handle at either end, by means of which the dies are rotated, pressure of the cutting edges on the work being effected by adjusting screws or screw wedges.

Stock Brick.—A hard, well burned brick, not quite perfect in form.

Stock Car.—On railroads, a special type of car for carrying live stock, having appliances for foddering and watering the animals.

Stock Gang.—An arrangement of saws in a gate, by which a log or balk is reduced to boards at one passage along the ways. The stock gang makes stock lumber, or regular market lumber, as distinguished from dimension lumber which is sawed to a specific size, as ordered.

Stocking Frame.—A frame or machine for weaving stockings or other hosiery goods.

Stocking Tool.—A broad nosed scraping tool, used in planing machines to take a finishing cut on iron.

Stockless Anchor.—An anchor which has no cross arm or stock and therefore can be drawn up into the hawse pipes, thus obviating catting and fishing.

Stock Tackle.—A tackle used when the anchor is hoisted and secured to keep its stock clear of the ship's side.

Stock Taking.—A periodical examination and inventory made of goods or stock in a works or warehouse.

Stock Work.—In mining, a system of working in ore, etc., when it does not lie in strata or veins, but in solid masses, so as to be worked in chambers or stories.

Stoker.—One who is employed to tend a furnace and supply it with fuel, especially that of a locomotive, or marine steam engine.

Stone.—1. A mass of concretioned, earthy, or mineral matter. In popular language, very large masses of stone are called rocks; small masses are called stones; and the finer kinds gravel or sand.

2. A weight used in England, which legally is *fourteen pounds*, but in practice varies with the article weighed; the stone of butchers' meat or fish is reckoned at 8 lbs.; of cheese, 16 lbs.; of hemp, 32 lbs.; of glass, 5 lbs.

Stone, Andros Boyden.—Born at Charlton, near Worcester, Mass., June 18, 1826, died in New York City, Dec. 15, 1896.

Andros B. Stone was one of a famous family of bridge builders. They exploited the Howe truss, the invention of William Howe, of Springfield, Mass., who had married their sister, who long survived her husband, dying at the age of 92. As a boy Mr. Stone early learned the meaning of poverty, and at the age of 15 he was apprenticed to a carpenter. He was subsequently enabled through his own exertions, to spend a brief term at an academy. Afterward, as clerk, he learned the details of the bridge building business. When 26 years old he became the head of the firm of Stone & Boumer, which built the first bridge across the Mississippi. Mr. Stone became a manufacturer of iron in Cleveland, in 1859, President of the Cleveland Rolling Mill Company, the American Sheet and Boiler-Plate Company, the Union Rolling Mill Company of Chicago, the Kansas Rolling Mills Company, the St. Louis, Keokuk and Northwestern Railway Company, and the Poughkeepsie Bridge Company. Becoming interested in Bessemer steel, Mr. Stone, made two visits to Europe for the purpose of its study, and afterward used that process at his mills in Cleveland. Here in 1869, the first steel rails were produced from American ore, and selling at one hundred and sixty dollars per ton. This was the crowning success of Mr. Stone's life. His later days were spent quietly in New York City, where, in 1871, he took up his residence. In 1881, he donated

the Summer home, at Bath Beach, Long Island, to the Children's Aid Society. He lived to see 80,000 children enjoy this benefaction.

Stone Boat.—1. A barge for carrying stone.

2. A drag, sled, or platform, used for carrying loads of stones short distances.

Stone Breaker.—In construction work, a machine for crushing or hammering stone for road or concrete work.

Stone Cement.—1. A hard composition of the nature of mortar, which will harden and form a watertight joint.

2. A mineral compound for uniting stone and resisting water, is made by mixing 19 pounds of sulphur, with 42 pounds of powdered glass or stoneware. Over a gentle heat the sulphur melts and the whole is stirred till a homogeneous mass is obtained when it may be run into moulds. It melts at 248 degrees Fahr.; it may be reformed indefinitely by remelting.

Stone Coal.—Hard coal; mineral coal; anthracite coal.

Stone Crusher.—A machine for breaking rock into pieces of various sizes; as, for road metalling, or concrete mixing; also used to crush ores preparatory to calcination and smelting. The machine consists essentially of two jaws, one fixed, the other at the extremity of a hinged lever; the swinging jaw is forced against the other with tremendous power, by means of a toggle joint, crushing the stone between them.

Stone Dressing.—The art of hewing or cutting stones to definite shapes: the term more explicitly signifies the imparting of a desired surface to the exposed parts of the blocks, the hewing to form and size being known as *stone cutting*.

Stone Drill.—A power driven drill for stone or rock. A *rock drill*.

Stone Hammer.—A hammer formed with a face at one end, and a thick, blunt edge, parallel with the handle at the other, used for breaking stone.

Stonehead.—In mining, the bedrock; solid rock underlying gravel or other deposits.

Stone Mason.—One who builds walls, foundations, bridges, etc., from stone.

Stone Quarry.—In civil engineering, a place, cavern or pit, where stone is taken from the rock or ledge, or dug from the earth, for building or other purposes; a *stone pit*.

Stones.—1. Pebbles; small pieces of rock broken off by the natural influences of weathering, frost, etc.; rock artificially broken into fragments for various purposes.

2. Rocks possessing sufficient hardness, durability or beauty, to render them fit for building into masonry structures.

Stone Saw.—For soft free stones an ordinary cross cut saw is used, but for harder stones a frame saw is employed; this is a toothless strip of iron about four inches wide by $\frac{1}{4}$ in. thick, fixed in a stretching frame, which is suspended from a tripod or gallows over the block to be sawed. Water and sand are fed into the groove made by the saw, and it cuts its way by friction alone.

Stone Walling.—In civil engineering, the work of walling with stone; also walls built of stone, or material used for stone walls.

Stoneware.—A species of potter's ware of a coarse kind, glazed and baked.

Stonework.—Masonry; the building of structures from dressed or prepared blocks of building stone.

Stooling.—In carpentry, a stone block serving as a base for a jamb or mullion, which is worked in the same block as the sill.

Stoop.—1. In architecture, a porch with a balustrade and seats on the side.

2. In coal mining, a pillar of coal left to support the roof of a mine.

Stop.—1. In carpentry, a wooden batten or block, against which a door or a casement window sash may close. Also a block to check sliding motion; as, of a drawer.

2. A device for arresting the motion of a moving part on a machine; a part of a gauge, against which the work abuts.

Stop Abutment.—In a viaduct, the thrust of one arch neutralizes that of the next, so the abutments need withstand weight only. However, as damage to one arch would leave the thrust unbalanced and might cause the ruin of the whole structure, a *stop abutment* is provided at regular intervals to provide for such an unbalanced thrust.

Stop Adjuster.—In carpentry, a device applied to the stop beads of windows or sliding doors. The screws securing the beads pass through an elongated hole in a round plate or socket in the stop, thus permitting adjustment of the stop as the sash swells or shrinks.

Stop Clutch.—A clutch fitted to large punching and shearing machines whereby the working head is connected with the continually revolving shaft of the machine or disengaged therefrom at the will of the operator. The stop clutch is generally worked by a treadle.

Stop Cock.—1. In pipe fitting, a small cock of globular pattern used for controlling the passage through brass fittings or the small pipes connected therewith.

2. An expression in occasional use to describe the valve on a boiler, controlling the supply of steam to an engine.

Stope.—In mining, a circular excavation in which the ore bearing material is removed in terraces or steps; as, *back stope* and *bottom stope*.

Stop Finger.—In manufacturing, a device in a silk doubling machine for stopping the motion of the *bobbin* if the thread breaks.

Stopping.—In mining, the act or process of cutting a stope, or step like excavation.

Stop Motion.—An automatic contrivance for stopping machinery to avoid injury to itself or to the material operated upon; more especially for stopping looms or spinning machinery upon the breaking of a thread.

Stopper.—That which closes or fills a hole or vent in a vessel.

Stopping Off.—In founding, the act of closing part of a mould with sand or other means to prevent the fluid metal running into it. Also called *gate shutter*.

Stopping Up.—In painting, the filling of small holes and cavities with putty so as to form a smooth surface for the paint.

Stopple.—That which stops or closes the mouth of a vessel; a cork stopper.

Stop Press.—A device for inserting late matter into a newspaper after it has gone to press. The paragraphs are set up in ordinary type and placed within a small brass case, termed the *fudge box*, having a width of one or two columns. The press is stopped, and the fudge box inserted into the rim of the type cylinder, at a special point where a blank space has been left for it in the stereotype. The make up of the paper is generally so arranged, that the fudge is inserted at the end of the cylinder. By the use of this appliance, it has been possible to have newspapers selling in the streets, bearing an account of an occurrence,

the news of which had been received in the office by telegraph a very short time previously.

Stop Valve.—An ordinary valve, usually for controlling the flow of steam to or from a boiler or engine.

Stop Watch.—A watch whose hands can be stopped in order to calculate the time that has passed.

Storage.—1. The act of storing or state of being stored.

2. The keeping or placing of articles in a warehouse.

3. A charge for storing goods.

4. In hydraulics, the artificial holding back of a body of water; as, to control the flow of water in irrigation.

Storehouse.—A building for keeping materials of any kind; a repository; a warehouse.

Store Keeper.—A man who has charge of the contents of a warehouse or shop.

Store Room.—Room in a storehouse; a repository; a room in which articles are stored.

Store Ship.—In navigation, a vessel used to transport stores to a fleet, garrison, and the like.

Storm Door.—In building, an extra outside door to prevent the entrance of wind, cold, rain, etc.; usually removed in summer.

Storm Forecasts.—Weather prognostications telegraphed by a meteorological bureau to different points for the public benefit.

Storm Pavement.—In hydraulic engineering, the sloping stone paving which lines the sea face of piers and breakwaters. The *breakwater glacis*.

Storm Sail.—A sail of reduced dimensions and specially stout canvas, bent in heavy weather; as, a *storm jib*.

Storm Signal.—A signal hoisted in prominent positions in seaports, notifying mariners that heavy weather may be expected, the direction from which the wind is approaching being also added. *Lloyd's signal stations* hoist a drum and cone made of canvas painted black and distended by hoops, the cone pointing upwards denoting a northerly gale, pointed downwards, a southerly one, the simultaneous hoisting of a drum under or over the cone, signifying a dangerous gale. Other stations announce telegraphed warnings by means of colored flags; all maritime countries unite in publishing these predictions.

Stove.—1. An apparatus, usually of iron, variously constructed, in which a fire is made for warming a room or shop, or for other purposes.

2. In smelting, a regenerator used to heat the blast or air supply by means of the waste gases.

Stove Screws.—Bolts and nuts used to secure the various parts of stoves and kitchen ranges. They have a square thread peculiar to themselves, and the bolt heads are fitted with a nick for a screw driver, being countersunk or hemispherical. Also termed *stove bolts*.

Stowing.—In mining, rubbish brought from the surface or from other portions of the excavation to fill worked out portions of the mine; the same as *packing*.

Stow Shaft.—A flexible shaft for the transmission of power around angles, etc. It consists essentially of a core of twisted wires, there being four or five layers of wire in the core, these layers being laid up alternately left and right handed. The connections, clutches, tool holders, etc., are soldered into the wires at either end. The wire shafts, which are usually from six to ten feet long, are enclosed in a case or covering of wire and leather, the core requiring to be well lubricated with lard, tallow or other *animal oil*.

Straddle.—In mechanics, to stand with the legs staggered; said of the spokes of a wagon wheel where they join the hub.

Straddle Mills.—In milling machine work, two cutters of the same diameter which straddle the work in making the cut.

Straight.—Right, direct; neither crooked, curved, nor deviating in any direction; in the shortest line between its two extremities.

Straight Air.—A pressure brake, in which compressed air from the engine reservoir is admitted to the train pipe to bring the brake cylinders of the various cars into action; the brakes being released by reducing the pressure in the pipe. It is occasionally fitted to engines and tenders and used in conjunction with the automatic brake, to provide means for checking the speed without stopping.

Straight Edge.—1. A bar of metal carefully planed and scraped on one or more edges to serve as a gauge or test for the accuracy of machine work or in adjusting or assembling machinery.

2. An engineer's steel rule, the edges of which are made straight for use as a *gauge* or *tester*.

Straightening Bed.—An arrangement of live rollers whereby and whereon steel rails, bars, etc., are straightened after rolling.

Straight Line.—The shortest distance between two points. It may also be taken as a portion of the circumference of a circle with an infinite radius; as, if the radius of the circle be anything less than infinity the line must be in some measure curved.

Straight Line Engine.—A type of horizontal automatic steam engine, designed by John E. Sweet. The feature from which it takes its name is the design of the valve gear which compensates for the *angularity* of the connecting rod in that it gives an equalized cut off. There are two fly wheels which serve as arms for the center crank, both being placed *between* the main bearings. The engine, to prevent rocking or swaying, is sustained by a three point bearing, formed by a pedestal under the cylinder and one under each main bearing. A fly wheel shaft governor controls the steam supply by altering the eccentricity of the eccentric, and thus varying the cut off.

Straight Line Motion.—A linkage of rods and pins to constrain some part to follow a straight line in its reciprocating path, like the Peaucellier or other *parallel motions*.

Straight Lipped Tongs.—Blacksmith's tongs for holding thin objects, the lips or gripping parts being parallel and square with each other.

Straight Pene.—Said of a hammer when the pene is wedge or hatchet shaped and parallel with the handle; used for chipping.

Straightway Drill.—A fluted drill made in the same manner as the twist drill, save that the grooves are straight and parallel with the axis.

Straightway Valve.—A valve whose two openings are in line with each other, as differentiated from an angle valve.

Strain.—1. To filter a liquid and free it of impurities by passing it through some medium or fabric which can retain the solid matter and allow the liquid to pass.

2. Change of shape or size of a body; any bending or breaking pressure is a *stress*; its effect on the piece a *strain*; briefly, then, the strength of a solid piece or body is the total resistance it can oppose to strain in that direction.

A piece of iron or timber may be subjected to strain or fracture in four ways: (a) It may be stretched, pulled or torn asunder; as, a tie rod of a steam boiler. This is called *tensile strain*.

or tension, and is a direct pull; resistance to this force is called *tensile strength*; (b) the iron or timber may be crushed in the direction of the length as in columns and truss beams. This is direct thrust, direct pressure or compression; and the resistance to it, *the crushing strength*. An example of this is found in the force tending to collapse the flues of a steam boiler; (c) it may be bent or broken across by a force perpendicular or oblique to its length, as in common beams and joists. This is *shearing strain* or flexion; resistance to it, *the shearing strength*; (d) it may be twisted or wrenched off, in a direction about its axis, as in case of shafting. This is torsion; resistance to it, *the torsional strength*.

Strainer.—1. That through which any liquid is passed for purification or to separate it from solid matter; anything, as a screen or a cloth, used to strain a liquid; a filter.

2. In paper making, an appliance, sometimes stationary, sometimes revolving, by means of which the pulp is passed through slits in brass plates, to maintain a uniform consistency and detain any lumps or impurities. Also known as pulp dresser.

3. In hydraulics, an appliance affixed to piping for the purpose of filtration or purification.

Straining Chain.—A chain used to hold things together, tension being applied by means of a screw or turnbuckle. In civil engineering, such chains may be used to secure four piles together, enclosing a rectangular space. In railway operation, to lash a load of timbers on a flat car; this use of a chain and screw is of wide application.

Straining Piece.—In shoring and heavy timbering, an abutment piece or stop, taking the thrust of a diagonal strut, etc. It serves to reinforce, or acts as a substitute for, a tenon or joggle.

Straining Sill.—In carpentry, a piece of timber on the tie beam, between the feet of the queen posts, to hold them against the thrust of the struts.

Strain Sheets.—An engineering term applied to the various sheets of drawings and calculations, used to determine with the utmost attainable accuracy the strength of the members, both iron and wood, of a structure; as, of a bridge or roof.

Strake.—1. An iron band by which the felloes of a wheel are secured to each other, being not continuous, as the tire is, but made up of separate pieces.

2. In shipwrighting, one breadth of planks or plates forming a continuous range on the bottom or sides of a vessel, reaching from the stem to the stern. Also spelled *streak*.

Strand.—An assemblage of several twisted yarns wound together. Hemp is twisted into a *yarn*, and several of the latter are twisted together, or, as it is called, laid up into a *rope*. Three strands thus laid are said to be *hawser* laid, the twist being the reverse of the individual yarns. Four strands thus twisted constitute the shroud hawser laid.

Strap.—1. A narrow piece of leather or other flexible material, used to retain something in place, or to surround and hold things together.

2. A driving belt; as, of leather or rubber.

3. A short piece of rope, spliced together at the ends, for use in slinging things together, for hoisting by a tackle; this has become more generally known as *strop*, the same spelling being adopted for the strap on which razors are sharpened.

4. A polishing belt, used by electroplaters, burnishers and brass finishers. Sometimes made endless, of two thicknesses of duck with india rubber between, but generally of heavy cotton duck, supplied in widths from one to six inches, the ends being sewed together. Emery powder, quartz, flint, or other abrading and polishing agents are used on the straps.

5. A narrow plate of thin iron, used to hold different wooden parts together, being secured to each piece by nails, bolts or screws; as, in securing the timbers of a roof, the sides of a box, or framing generally.

6. The leaf of a hinge.

7. The hoop shaped piece, generally in halves, which surrounds an eccentric sheave, transmitting its motion to the valve gear.

8. In a steam engine, the stirrup shaped piece, which surrounds the brasses in the stub end of certain types of connecting rod or pitman.

9. The stirrup shaped part of a clevis or shackle.

Strap Brake.—A simple variation of the Prony brake for testing the horse power of engines. A strap or piece of belt furnished with shoes is so disposed around the fly wheel as to form a *fl*; the curve enclosing at least half the circumference of the wheel, while a steelyard is interposed between either end and the floor or foundation. An arrangement is made for adjusting the tension on the tight side of the strap, so as to insure a fair pull, and the product of the difference between the indications, on the two spring balances, multiplied by the linear velocity of the rim, in feet per minute, gives the power supplied by the engine.

Strap End Connecting Rod.—A type of connecting rod end, frequently employed with small engines, the brasses for cross-head and crank pins being held to the stub ends of the rod by steel straps or stirrups, the straps being secured by through bolts, and adjustable by means of a gib and cotter, or a screw cotter.

Strapping Lathe.—A polishing apparatus having a number of pulleys, and a tension apparatus, over which runs an endless polishing belt or *strap*.

Strap Rail.—In a railway, a flat iron bar laid on a continuous longitudinal sleeper, as used in some old constructions.

Strass.—A very clear glass, used in the manufacture of *paste* or artificial gems; so named from its German inventor. Strass contains large proportions of oxide and borate of lead; is soft, easily fused, and possesses high refractive power.

Strata.—The plural of *stratum*, folds or layers. A term applied to those rocks, among the constituents of the earth's crust, which present the appearance of successive layers piled upon each other. Such rocks have been deposited under water as the sediment resulting from the disintegration of older materials, and have hardened into stone; the succession of beds has been due to the rise and fall of the earth's surface, whereby the same area has been alternately sea and land, each change causing the deposition of a different stratum. The action of the same internal forces has produced tiltings, contortions and curvature in what were once horizontal layers.

Stratified.—In geology, said of rocks which are arranged in beds or layers, having been originally deposited in horizontal sheets under water, as a sediment resulting from the disintegration of older rocks.

Straw.—The stalks of certain species of grain when cut and after being thrashed; as, a bundle, or a load of straw. Two compositions of straw (as a fuel) average as follows: (1) water, 14%; (2) combustible matter, 79%; (3) ash, 7%.

Straw Board.—Thick paper board or millboard, made chiefly or entirely from straw, generally that of wheat or rye. Used largely by bookbinders.

Straw Boiler.—In a paper mill, a vessel for boiling and softening straw to form paper stock.

Straw Carrier.—1. An endless apron in a thrashing machine, to lift the straw as it comes from the cylinder, and discharge it at the tail of the machine. The carrier being of open work, the grain and chaff are sifted out on the way.

2. A straw elevator at the end of the thrasher, to lift the straw on to the rack.

Straw Firing.—The operation of burning straw under a boiler, consists in the fuel being fed into the furnace only as fast as needed. When the straw is handled right, it makes a beautiful and very hot flame and no

smoke is seen coming from the stack. The whole secret of getting the best results from this fuel is to feed it into the furnace in a gradual stream as fast as consumed. When this is done complete combustion is the result. A little hole may be drilled in the smoke box door, so that the color of the fire can be seen and the fire handled accordingly. When the smoke comes from the stack the color of the flame is that of a good gas jet. By feeding a little faster the color becomes darker and a little smoke comes from the stack; feeding faster the flame gets quite dark and the smoke blacker; faster still, the flame is extinguished, and clouds of black smoke come from the stack.

Stream.—1. A course of running water; as, of a river or brook.

2. Anything flowing or moving in a current; as, a liquid or a fluid.

Stream Wheel.—In hydraulics, an under-shot or current wheel propelled by a running stream.

Street.—A thoroughfare within a town or city, with houses on either side. In English cities, a narrower and less important thoroughfare or public way than that is designated as a *road*, which latter usually corresponds to one of the ancient roads of travel. In American cities, the thoroughfares, usually the more important, in one direction are termed *avenues*, those transverse to them being termed *streets*.

Street Car.—A passenger car that runs on rails laid on the surface of the streets, moved by horses, electricity, cable, etc.; a car on a street railway.

Street Sweeping Machine.—A wagon provided with scrapers and brushes for gathering up street dust, etc., and depositing it in the wagon bed hanging between the axles.

Strength.—Power to resist force; solidity or toughness; the quality of bodies by which they endure the application of force without breaking or yielding.

Strength of Materials.—A general expression for the measure of capacity of resistance, possessed by solid masses or pieces of various kinds, to any causes tending to produce in them a permanent and disabling change of form or positive fracture.

Materials of all kinds owe their strength to the action of the forces residing in and about the molecules of bodies (the molecular forces), but mainly to that one of these known as *cohesion*; certain modified results of cohesion, as toughness or tenacity, hardness, stiffness, and elasticity are also important elements, and the strength is in the relation of the toughness and stiffness combined.

Stress.—1. The force, or combination of forces, which produces a strain; force exerted in any direction or manner between contiguous bodies, or parts of bodies, and

taking specific names according to its direction, or mode of action, as *thrust* or pressure, *pull* or tension, *shear* or tangential stress.

2. In mechanics, the mutual action between two portions of matter.

Stress Diagram.—A graphic representation and calculation of the stresses in a structure, in which all the forces are drawn to lengths corresponding with a chosen scale, and shown in their proper relations and directions to each other, their resultants being determined therefrom by simple measurement.

Stretcher.—1. In building, a brick laid in course parallel to the face of a wall, or longitudinally; those laid across are termed *headers*.

2. A light portable bed for carrying the sick, made of a framework of poles, with a piece of canvas stretched between them. Doors, window-shutters, etc., can be used as emergency stretchers. "Carry stretcher in hands or suspend it by straps over bearers' shoulders. Bearers march in broken step, not in time. In ascending, patient's head to be in front and in descending behind."

Stretcher Bond.—In building, a form of bond in which the bricks or ashlar are laid lengthwise in successive courses, so that the joints of one course are at the middle of those of the adjacent courses.

Stretcher Mule.—In spinning, an intermediate mule used to stretch and twist fine rovings preparatory to spinning into yarn.

Stretching Frame.—1. In spinning, a machine for stretching rovings preparatory to spinning into yarn.

2. In cotton finishing, a frame on which starched fabrics are stretched to dry.

Stretching Screw.—A screw fitted with a swivel eye, and working in a nut suspended from a traveler, by means of which cylinder covers, pistons, valves and the like are lifted for examination.

Strick.—In textile manufactures, a bunch of flax, jute or similar fiber, sorted and heckled, or laid out for heckling.

Strickle.—1. To smooth off the dry contents of a vessel by passing a stick across its upper surface; said of measuring grain by the bushel.

2. To sleek the surface of a mould, in founding, as above.

Strike.—1. To touch or hit, with some force, either with the hand or with an instrument.

2. In masonry, to cut off, as a mortar joint, even with the face of the wall, or inward at a slight angle.

3. To quit work in order to bring the employer to terms.

4. In iron working, a puddler's stirrer.

Striker.—1. A blacksmith's helper who wields the sledge; a hammerman.

2. A harpoon, also a harpooner.

3. A workman who is on *strike*.

Striking Gear.—The bar with lever, forks and fittings, by means of which the driving belt of a machine is shifted from the tight to the loose pulley, or vice versa. The lever that operates the striking gear is sometimes known as the *shifting lever*.

Striking Machine.—A leatherworker's machine for scraping hides, to remove the *bloom* therefrom. The hide passes between two rollers, the upper furnished with a spiral knife, the lower being held up by springs, which accommodate themselves to the varying thicknesses of the leather and press it against the revolving knife.

Striking Pan.—In sugar making, the last of a series of evaporating pans, in which the more concentrated liquor collects; also termed *striking tache*.

String.—1. A cord of small diameter.

2. In mining, a small vein of ore, running from the main vein and passing off into the rock. Still smaller veins are called *threads*.

3. In shipwrighting, the uppermost row of planks in a ship's ceiling, or that between the upper edge of the upper deck ports and the gunwale.

4. In masonry, a projecting course of bricks or stones in a wall. A *string course*.

String Binder.—A harvesting machine which uses a coarse two strand cord to tie the sheaves of grain.

Stringer.—1. In carpentry, a horizontal timber connecting posts in a frame; as, a tie timber of a truss bridge or a horizontal tie in a floor framing.

2. In railway engineering, a longitudinal balk or timber on which a railway is fastened, and which rests on transverse sleepers.

3. In shipwrighting, an inside strake of plank or of plates secured to the ribs and supporting the ends of the beams; a *sheep piece*.

Strip.—1. To tear off; as, the thread from a bolt or nut.

2. A narrow piece; as, a *strip* of land

3. In navigation, to dismantle; as, to *strip* a ship of rigging, spars, etc.

4. In mining, to remove the soil covering any mineral it is desired to work.

Stripe.—1. In decoration, a linear variation of color, or long line or strip of any color different from the main ground. Such ornaments are known as *lines*, if under $\frac{1}{4}$ inch in width, as *stripes* from $\frac{1}{4}$ to $1\frac{1}{2}$ inch, above $1\frac{1}{2}$ inch as *belts*.

2. In fabrics, a line or strip of a color or shade varying from that of the main texture.

Stripper.—A pivoted lever, fitted to a power punching machine, whose jaw straddles the punch and strips or pulls off the perforated plate as the punch rises.

Strockle.—In glass making, a shovel for frit, sand, etc. It has turned up edges to increase its holding capacity.

Stroke.—The linear distance traveled in one motion by a piston or ram, whether in an engine or pump. The entire movement of the piston, from one end to the other of the steam cylinder. The respective strokes are distinguished as *up* and *down* strokes, or *front* and *back* strokes, the front stroke being toward the crosshead. In the United States, the stroke of a locomotive piston toward the front of the engine is called the *front stroke*. The term is also applied to the movement of the crosshead and other parts moving with the piston. The movement of a slide valve is called its *travel* or *throw*. The movement of an eccentric is called its *throw*. Confusion results from the improper use of the word *throw* which means the entire linear movement produced by an eccentric and not half the movement.

Stroked Work.—In masonry, when the toolmarks are made in a slanting direction instead of at right angles to the bed of the stone.

Strong.—1. Having great physical power.
2. Solid; tough; not easily broken.

Strong Sand.—That which contains a large quantity of clay, and is therefore tenacious.

Strontium.—A white, malleable metal, of but little importance from a mechanical point of view, its salts used in pyrotechnics to give a red glare.

Strop.—In rigging, a short sling; a piece of rope spliced into a circular wreath, and put round a block for hanging it.

Structural Iron Work.—The cast iron, and cast and wrought steel work entering into the construction of a building,

comprising posts, pillars, caps and bases; rolled joists; cast, rolled or built up girders; sectional iron bars, etc.

Structural Load.—In mechanics, the load due to the structure itself, as distinguished from the *imposed load*.

Structure.—1. That which is built, a building.

2. The arrangement of parts formed in one body, as, a machine or a bridge.

Strum.—1. In hydraulics, a rose or perforated end for a suction pipe.

2. A grating, strainer, or the like, to prevent the entrance of solid matter into the chambers of a pump.

Strut.—Any part of a machine or structure of which the principal use is to hold things apart; the opposite of *stay* and *tie*. In general, any piece of a frame which resists thrust or pressure in the direction of its own length.

Strutting.—1. Diagonal braces between the joists in a floor to prevent sidewise deflection; the pieces are frequently crossed over each other, forming an elongated St. Andrew's cross; at other times they may incline alternately in each direction, forming *herring bone* strutting.

2. Shoring by means of struts. A shore that approaches the horizontal is known as a *strut*.

Stub.—One of various short or blunt objects; anything short, truncated or stumpy; as, a *stub file*.

Stubble.—The stubs of grain stalks covering a harvest field after the crop has been cut and gathered.

Stub Brass.—In a steam engine, the brass step or bearing made in halves which fits into the stub ends of a connecting or coupling rod.

Stub End.—In a steam engine, a term applied to the enlargement at either end of the connecting or coupling rod, including the bearing brasses for the crank or wristpin, and the strap employed in certain designs to hold them in place.

Stub Iron.—Iron made from old horse shoe nails, said to be valuable for making gun barrels.

Stub Mortise.—In carpentry, a mortise which does not pass through the object in which it is made; not a through mortise.

Stub Short.—In wood turning, that part of a piece of material, as wood, which is to be cut away from the end, in turning in a lathe, only when the turning is finished. Also called *stub shot*.

Stub Tenon.—In carpentry, a short tenon at the foot of an upright, such as the scantling or studding of a partition or a floor bearer.

Stub Wedge.—In mechanics, a wedge used to retain in position and adjust the brasses in a solid rod end. A bolt or thread is formed on the small end of the wedge, and permits it to be drawn tight or retained in place by lock nuts pressing against the side of the rod.

Stub Wedge Bolt.—A bolt or set pin screwed through the side of a stub end, locking the wedge so that it may not slack back.

Stucco.—1. In building, a fine plaster or cement made from powdered white marble, plaster of paris, sand and water, used for the exterior walls of buildings, and ornament in relief.

2. Any plaster or cement used as a covering of the outside walls of a building, generally finished to imitate stonework.

Stud.—1. A short rod, fixed in and projecting from something; sometimes forming a journal.

2. In machine shops, a boss or protuberance designed to hold an attached object in place.

3. In carpentry, an upright scantling.

4. A nail with a large head.

5. In a chain, a cast iron brace across the minor diameter of a cable link, to prevent collapse.

Stud Bolt.—A bolt with threads on both ends to be screwed into a fixed part at one end and receive a nut upon the other.

Studding.—1. In building, scantlings or battens, in the frame of a wooden structure, to which are nailed the matchboarding, sheathing or siding.

2. In engineering, lengths of screwed rod from which pieces are sawed off to form studs as required.

Studding Sail.—(Abbreviation *stuns'l*.) A light air sail mounted on booms at the extremities of the yards.

Studdle.—1. In mining, an upright prop supporting a platform in a mine, usually one of a set of four.

2. In weaving, a prop or bar in a loom.

Stud Link Chain.—A chain, each link of which is fitted with a transverse stud, usually of cast iron or cast steel, which keeps the sides apart and tends to prevent deformation of the link under strain. Chain cables are generally made on this plan.

Stud Work.—In building, brickwork between studs. An old form of building, once common in England and afterwards introduced into the United States by admirers of the ancient and picturesque.

Stuff.—1. Material which is to be worked up in any process of manufacture.

2. Refuse or worthless matter.

3. In rigging, a melted mass of turpentine, tallow, etc., with which the masts and booms of derricks are smeared for lubrication and preservation.

4. In mining, mixed ore, veinstone, and country rock as brought to surface.

Stuff Chest.—In paper making, the same as *agitator*.

Stuffing Box.—An arrangement for rendering a joint tight where a movable rod passes into a vessel of some kind; as, the cylinder of a steam engine. It consists of a closed box, cast round the hole through which the rod passes, in which is laid round the rod and in contact with it, a quantity of hemp or india rubber packing, metallic or rubber rings, and the like, lubricated with oily matter, and pressed closely down by a ring.

Stull.—In mining, a platform used in overhead or back stoping, on which the rubbish is placed; also known as *bunning*.

Stumble.—1. A trip in walking or running.

2. A blunder; a failure.

Stump.—1. In lock making, a projection, generally stationary, variously employed as a support for a dog, fence or tumbler, as an obstruction to prevent the improper retraction of the bolt, or as a guide for any of the moving parts.

2. A draughtsman's soft rubber.

Stump Puller.—In railroad construction, an appliance made in different forms for extracting the stumps of trees from the soil: (1) A ring or hook at one end of a long lever embraces the stump, and a team of horses, pulling at the other end, twists the stump off its roots; (2) a ring carrying a trepanning tool is mounted on the stump, and, being revolved by horse power, cuts through all the roots; next, a hook or chain, as in (1), is hitched around the stump itself and it is twisted off; (3) the roots being cut through with an axe, a tripod is erected over the stump, and by means of a combination of ratchet gear and differential pulleys it is easily lifted by one or two men.

Style.—1. A sharp pointed tool used in engraving; a graver.

2. Conformity to a recognized standard.

Sub.—1. In well boring, a short name for *substitute*; a short section of rod for connecting tools or bars of different sizes.

2. A subordinate; a subaltern.

Subcontractor.—A person or firm who contracts to execute minor details, or separate portions of any work which has been contracted for as a whole by larger firms; thus, in building a house, the painting and plumbing would usually be let by the builder to separate persons engaged solely in that class of work.

Subdivision.—A part divided from a part, which was divided from the main part; as, the dividing of a plot of land into town lots.

Subject.—1. That which is placed under the authority, dominion, control, or influence of something else.

2. That which is brought under thought or examination; that which is taken up for discussion, or concerning which anything is said or done.

Sublet.—1. To let work that one has contracted to do, to a subordinate contractor; underlet.

2. To let, or lease to another, property that one holds by a lease; sublease.

Sublimate.—In physics, to bring by heat into the state of vapor, which, on cooling, returns again to its natural state.

Sublime.—In chemistry, to pass off in vapor with immediate condensation; specifically, to evaporate or volatilize from the solid state without apparent melting.

Submarine.—Being, acting, or growing, *under the sea*; as a submarine war vessel.

Submarine Cable.—A wire or combination of wires protected by flexible non-conducting waterproof material, designed to rest on the bottom of a body of water, and serve as a conductor for the currents transmitted by a telegraphic instrument.

Submarine Telegraph.—A device whereby messages are electrically transmitted through copper wires laid at the

bottom of the sea. The wires are insulated in gutta percha, tarred manila, and gutta percha again; those cables near the shore which are subject to chafing on the rocks being further protected by an armoring of plaited steel wires.

Submerge.—In mechanics, to cause to plunge or sink under water, to inundate and drown, or cover with water.

Submerged Condenser.—In refrigerating machinery, a surface condenser of the usual type, in which water is circulated through the tubes or around them.

Submerged Pump.—1. One that works entirely under water; as, in draining flooded mine workings, compressed air or hydraulic pressure being used as a motive power.

2. A pump which is so arranged that its feed supply is at a higher level than itself, insuring its chambers being full of water at each stroke, hence there is no lift, and the foot valve is generally dispensed with, the head and bucket valves being sufficient.

Submission.—Surrender of the person and power to the control or government of another. Obedience; compliance.

Subordinate.—Holding a lower position in power, importance, or the like.

Subscribe.—To set one's name to a paper in token of promise to give a certain sum.

Subsequent.—1. Following in order of place.

2. Coming or being after something else at any time.

Subsill.—A horizontal member forming part of the foundation of a structure of any kind.

Subsoil Plow.—One having a share and standard but no mould board. Its duty is to follow in the furrow made by an ordinary plow, and loosen the soil to an additional depth, without bringing it to the surface.

Substance.—The material of which anything is made; the essential part of anything, said or written, put into a brief condensed statement.

Substitute.—In well boring, an optional bar or section; as, the *substitute sinker bar*, a shorter section to be used when a full length section is not suitable, or, a short section of sinker bar having flanges to ream the hole and keep it straight.

Substructure.—An underbuilding; the foundation or any preliminary building

intended to raise the lower floor or basement of a building above the natural level of the ground.

Subtend.—In geometry, to extend opposite to; to form the chord of an arc.

Subterranean.—Underground; a term applied to any passage or working beneath the surface of the earth.

Subtraction.—In arithmetic, taking one number from another. The answer is called the *remainder* or *difference*.

Subtrahend.—In arithmetic, that which is to be subtracted; a quantity which added to the remainder produces the *minuend*.

Suburb.—1. An outlying part of a city or town.

2. A smaller place immediately adjacent to a city.

Subway.—1. An underground passage or footway, for facilitating safe transit from one side to another of crowded thoroughfares or from one platform of a railway station to another.

2. A shallow underground urban railway, just below the surface level, reached from the street by a few steps only, like the Paris Metropolitan, the London Underground, or the New York Subway, as against a deep level line like the London Tubes.

Sucker.—1. A piston, as of a syringe or of a suction pump; as, the plunger or bucket of a deep well pump, such as is used in pumping non-flowing oil wells.

2. A tube or pipe used for suction.

3. A leather disk having a string inserted in its center: a contrivance illustrating atmospheric pressure when the wetted disk is pressed so closely as to expel all air beneath an object, as an iron plate, or a stone being lifted by pulling the string.

Sucker Rod.—In bored wells, the jointed pump rod, which carries the bucket at its lower end, and is actuated by the walking beam at its upper.

Sucking Wind.—When a pump has drawn its source of supply down to such a degree that air enters the suction opening along with the liquid, making a characteristic noise.

Suction. The act or process of drawing in; as, a liquid into a chamber or pump, by removing the air pressure from the surface of the liquid in the supply pipe, the external pressure of the atmosphere causing the fluid to rise in the pipe and enter the pump or chamber.

Suction Box.—In paper making, the same as *vacuum box*.

Suction Chamber.—An air vessel on the suction side of a pump, to produce a nearer uniform flow of the fluid and so reduce shocks. Also called *air chamber*.

Suction Dredge.—In hydraulics, an appliance for removing bars and other impediments to navigation, where the bottom is sandy or muddy, operating through the suction of powerful centrifugal pumps. The suction pipe has a mouth piece terminating in points, like a huge crown cutter, which cut loose the hardened sand, aided by high pressure jets of water. The water carries the sand into the pump, which delivers it into hoppers on either the dredger or on barges alongside. The proportion of sand to total quantity pumped is from 60 to 70 per cent., the object of all improvements being to lessen the quantity of water necessary.

Suction Hose.—Fabric, leather, or rubber hose armored internally with a coiled wire, to prevent collapse under the suction of a pump.

Suction Lift.—In a pump, the height to which a column of fluid will rise in the suction pipe of a pump, due to the pressure of the external atmosphere. Theoretically this corresponds to about 34 feet with water, but the resistance of the valves, friction through passages, etc., together with the probability of minute leaks in the suction column, fix a maximum working limit of about 25 feet.

Suction Pipe.—In railroads, etc., a hose or pipe leading from the tender or water tank to the suction connection of the injectors of an engine, to supply them with water.

Suction Producer.—A type of gas producer, in which the air is drawn through the incandescent carbon by the suction caused by the engine piston on its charging stroke. In starting, the gas producer is brought up to its proper heat by a fan blast, hand or power driven, but, as soon as the engine has had an explosion, the producer functions act automatically. Also called *gas producer*.

Suction Tube.—An airtight conduit or pipe fitted to parallel flow turbines, and discharging below the tail race. The advantage is that the turbine has equal efficiency if placed in any part of the pipe, as long as its height is not above 30 to 32 feet to balance the pressure of the atmosphere. By this device, the whole force of the fall may be utilized, yet the turbine is kept clear above the tail race, for overhauling and repair.

Sufficient.—1. Equal to the end proposed.
2. Adequate to wants; enough; ample.

Sugar Cane.—A tall, stout, perennial grass of tropical regions, the principal source of the sugar of commerce. It

resembles sorghum and Indian corn in its broad flat leaves, and is from eight to twenty feet high. Its native country is unknown, but it was introduced by the Venetians about the middle of the 12th century into the islands of the Mediterranean, whence through Spain and Portugal it passed to America where it was firmly established by the middle of the sixteenth century.

Sugar House.—A building in which sugar is made or refined; a sugar manufactory.

Sugar House Pump.—A steam pump, designed to deal with hot semi-liquids, such as the various magmas handled in a sugar house, *masse-cuite*, second and third sugars, etc. The pump ends are usually wholly of brass, with very large valves and passages, a slow motion being generally given to the pump.

Sugaring Off.—The process of boiling and condensing into sugar, the maple syrup tapped from the trees; observed as a social and festive occasion in Canada and the northern United States.

Sugar Mill.—A machine for pressing out the juice of the sugar cane, usually consisting of two or more rollers, between which the cane is passed.

Sugar of Lead.—Acetate of lead, so called on account of its sweet taste; it is prepared by dissolving litharge in acetic acid accompanied by heat. It is a white solid, very soluble in water, and less so in alcohol, a virulent poison. It is used in medicine as a reagent, and in the preparation of other lead compounds. A preparation is known as *Goulard extract*.

Suggestion.—A hint; an intimation; that which is suggested.

Suint.—In chemistry, a peculiar substance obtained from the wool of sheep, consisting largely of potash mixed with fatty and earthy matters. It is used as a source of potash, and also for the manufacture of gas.

Suit.—1. The act of following or pursuing.

2. A number of things used together, and generally necessary to be united in order to answer their purpose.

3. Regular order.

4. In law, the attempt to gain an end by legal process; an action or process for the recovery of a right or claim.

Suji Muji.—A term from the Hindustani, for a composition of lime and soda to remove old paint; a cleansing powder for washing paint work, etc.

Sulky Plow.—A plow mounted on wheels and provided with a seat for the driver.

Sullage Piece.—In founding, a feeding-head; a piece of metal on a casting which occupies the ingate where the metal enters the mould when it is desired that a heavy casting, such as a steamboat main shaft (or cannon) of several tons should be especially solid; it is always poured on end, and, in addition to the length required, a continuation of the mould upward is made. In this piece the sullage rises. When the casting is cold, the portion added is cut off and with it the floating impurities are removed.

Sullage Tank.—In a steam or other vessel, a tank in the bilges into which drain the sinks and closets below the water line. This tank is flushed and pumped out by a special sanitary pump.

Sulphate of Aluminum.—A white powder formed by heating bauxite with strong sulphuric acid, or by roasting alum shale in the air. It is used in paper making, in tanning, in the preparation of alum, and as a precipitant for sewage.

Sulphate of Ammonia.—A white solid, formed by the union of ammonia and sulphuric acid; a most valuable fertilizer, recovered from the ammoniacal liquor of gas works, from the gases of blast furnaces, the scrubbers of fuel gas producers, etc.

Sulphate of Copper.—The commonest salt of copper; a white solid, but which readily absorbs five molecules of water of crystallization, turning blue and becoming *blue vitriol* or *blue stone*.

Sulphate of Iron.—Ferrous sulphate, also known as *copperas*, or *green vitriol*.

Sulphates.—These are chemicals, formed by the action of sulphuric acid (commercially known as the oil of vitriol) upon an element, such as sodium, magnesium, etc.

Sulphide.—A compound of sulphur with one other element, or with a group of elements acting as a single element. Metallic sulphides may be regarded as the salts of sulphureted hydrogen.

Sulphide of Hydrogen.—Sulphureted hydrogen, much used as a reducing agent.

Sulphur.—An elementary mineral substance, of a yellow color, brittle, insoluble in water, easily fusible and

inflammable; also called *brimstone*, that is, *burn stone*, from its great combustibility. It burns with a blue flame and a peculiar suffocating odor.

Sulphur Dioxide.—In physics, a gas formed by burning sulphur in dry air, and composed of one part of sulphur to two of oxygen. It is easily liquefied under pressure, and cold, consequently is used as a refrigerating agent; also to bleach straw goods, etc., and as a disinfectant.

Sulphureted.—Having sulphur in combination; containing, or combined with, sulphur.

Sulphuric Acid.—An acid formed by one atom of sulphur combined with two of hydrogen and four of oxygen, formerly called vitriolic acid, and also known as *oil of vitriol*. A dense, heavy, oily liquid, exceedingly corrosive, decomposing all animal and vegetable tissues, and having a great affinity for water, which it absorbs with the evolution of heat. It is made by burning sulphur or iron pyrites in closed furnaces, the fumes from which, intermingled with nitrous oxide, distilled from sodium nitrate by sulphuric acid, are led into leaden chambers into which steam jets are blown, where the sulphuric acid is deposited. Whatever fumes escape are led up towers filled with pieces of coke, down which water sprays are trickling, thus trapping the acid. The resultant liquor in the chambers is concentrated in leaden pans, until the ordinary commercial strength of 78% is reached.

Sulphuric Ether.—Properly known as diethyl ether; it may be regarded as ethyl alcohol partly dehydrated, and is made by distilling sulphuric acid with an excess of rectified spirits. It is a mobile liquid with characteristic smell, having a specific gravity of 0.736. The inhalation of its vapor produces unconsciousness, hence, it is used as an anæsthetic; it is a valuable solvent for organic substances, such as fats and oils; is extremely inflammable and makes an explosive mixture with air. It is used sometimes as a refrigerating fluid.

Sulphuring.—The act or process of exposing to the fumes of burning sulphur.

Sulphurous Acid.—A gas used in refrigeration, consisting of two equivalents of hydrogen, one of sulphur, and three of oxygen, formed by burning sulphur in air or dry oxygen, and leading the gas through water. Sulphurous acid is easily liquefied, is incombustible, has no chemical action upon metals or fats, is a good lubricant and is cheaply made; but it has the great disadvantage of requiring a very large compressor, nearly three times as large as an ammonia plant of the same power.

Sulphurous Anhydride.—A gaseous oxide of sulphur, or sulphur dioxide. A very heavy gas, freely soluble in water;

is neither combustible nor a supporter of combustion, is very poisonous. It is used as a medium for refrigerating machines; as a disinfectant in rooms which have been occupied by sick persons; as a preservative in solution for painting over meat in hot weather; as a bleaching agent for material, such as blankets or straw, which would be injured by chlorine.

Sum.—In arithmetic, a problem to be solved, or an example to be wrought out; the aggregate of two or more numbers.

Sumach.—A tanning material derived from the finely ground leaves of the Sicilian Sumach and the myrtle leaved Sumach. These are both very rich in tannin and are cultivated for its production in Southern Europe. Wild sumach is also found in the State of Virginia.

Summer.—In carpentry, a girder or main beam supporting a floor. If supported on posts or walls at the ends over an open space, it is termed a *brace summer*.

Summer Stone.—In building, the lowest stone at the side of a gable, including the first portion of the coping.

Summing Up.—1. An abridgment; a summary.

2. To cast up; to collect.

Sump.—1. The cistern or reservoir made at the lowest point of a mine, from which is pumped the water which accumulates there. Also called a *wind bore*.

2. A masonry pit lined with clay to receive molten metal.

3. A pond at a salt works.

Sump Fuse.—In mining, a fuse enclosed in a waterproof case, for blasting under water.

Sun and Planet Motion.—In steam engineering, a device invented by James Watt as a substitute for the crank. A spur wheel, termed the *sun wheel*, is keyed to the engine shaft; the *planet wheel* of equal size, meshing with the sun wheel, is secured to the end of the connecting rod, not being able to revolve on its own axis, and the movement of the engine causing the axis of the planet wheel to revolve around that of the sun wheel, giving it revolution in the opposite direction.

Sun Burner.—In architecture, a large reflecting cluster of burners placed around and beneath an opening in the ceiling of a building, thus providing ventilation as well as light.

Sunk Fence.—A ditch with a retaining wall, used to divide lands without defacing a landscape; a *ha-ha* or a fence of bushes, planted low.

Sunk Motion.—In millwrighting, etc., transmission gearing which is placed below the level of the floor, especially in rolling mills and the like.

Sunk Panels.—In building, recessed compartments in a wall or ceiling, surrounded by mouldings on their edges, often with a rosette or other ornament in the middle.

Sunlight.—The light of the luminous orb; the light which constitutes day, and its absence night.

Sunn.—A valuable substitute for hemp, obtained from an East Indian plant, cultivated in many parts of Hindostan.

Sun Plane.—A cooper's tool, operated as a jack plane, but having a stock of circular shape. It is used to level down the ends of the staves of a cask, the chamfer of the chime being made by the *hovel*, and the groove for the head by a *croze*.

Sun Print.—In mechanical drawing, a photographic representation of a negative or tracing obtained by the action of sunlight on sensitized paper; a *blue print*, as used by draughtsmen and engineers.

Sunstroke.—Any affection produced by the action of the sun on some part of the body, especially a sudden prostration of the physical powers with symptoms resembling those of apoplexy, occasioned by exposure to excessive heat. Treatment: "Put patient in cool place, apply ice water and pounded ice in cloths to the head, back of neck and spine. In case more of exhaustion than of sunstroke, give stimulants gradually and be sparing of the ice and cold water."

Sunwise.—In the direction of the sun's apparent motion, or from the east to the westward, and so around the circle.

Superficies.—In geometry, a surface or area, enclosed by bounding lines.

Superheated Steam.—Steam having a temperature higher than that corresponding to its pressure; also called *surcharged steam*, and *steam gas*.

Superheater.—In steam engineering, an arrangement of tubes and headers placed in a boiler to impart heat to the steam in addition to that which it already holds as saturated steam, and thereby giving it power to do more work. This additional heat is imparted after the steam leaves the *dry pipe* and before it enters the steam chests.

Superintendent.—A general manager of a factory; the official responsible for the actual carrying on of the work, as apart from designing or from the mercantile departments.

Superintendent of Motive Power.—That officer of a railway who is responsible for its locomotives; their design, usually their construction, their maintenance and repair, and their work. The trainmen are his subordinates, although, from the necessities of the case, their running has to be in accordance with the instructions of the traffic department.

Superior.—1. Higher; upper, as compared with something else.

2. Of higher quality in comparison, or in higher degree.

Supervisor.—1. An overlooker or inspector; an official who sees that things are carried out or done in a proper manner.

2. An elected officer, in certain of the United States, chosen individually, or as a member of a body, by the inhabitants of a township or town to superintend its general administration.

Supplement.—1. To make an addition to; to add or confer something extra or additional.

2. Something given or placed in addition; an extra part or piece.

3. In geometry, mensuration, etc., the difference between any given angle and 180° . The difference between an angle and 90° is its complement.

Supplemental Piston.—In a vertical marine condensing steam engine, a small piston working in a cylinder and attached to an extension of the valve stem. The cylinder being connected by a pipe to the condenser, a vacuum is maintained therein, which acting on the piston, balances the weight of the valve.

Supplementary.—Additional; that which supplies a deficiency or meets a want.

Supplies.—Requisites; stores, provisions, or other essential requirements provided for carrying on any business, art or manufacture, for traveling or navigation.

Supply.—1. To provide, furnish, make provision for; to fill a want or deficiency.

2. That which is supplied or provided.

Supply Channel.—In hydraulics, an open channel excavated in the earth or built

out of masonry, wood, cast or wrought iron, which leads the water from the highest available level to the site of the machinery.

Supply Pipe.—In railway engineering, a pipe sometimes connected to the air inlet of an air compressor, by means of which the air supply is drawn from a point away from the compressor.

Support.—1. That which upholds, sustains, or keeps in an upright or elevated position.

2. The stand, frame, base or foundation upon which anything rests.

Surbase.—In joinery, a board running around a room on a level with the top of the chairbacks.

Surcharged Wall.—In civil engineering, a retaining wall, holding back an embankment of earth which slopes away upwards from the top of the wall.

Surd.—In mathematics, a number which cannot be clearly expressed; as, the ratio between two whole numbers; as, the ratio of the circumference of a circle to its diameter, or $\sqrt{2}$.

Surface.—1. In steam engineering, a portion exposed to heat; especially, the combined area of the walls of the tubes or flues of a boiler.

2. That which possesses length and breadth only.

Surface Blow Cock.—In steam engineering, a valve of a boiler, so arranged as to clean off the top scum, by letting out a part of the steam and water under pressure.

Surface Blow Off.—A method for discharging floating impurities on the water level of a boiler. A tray collects the dirt on the surface of the water and a pipe connected to a special blow off cock conducts water and impurities outside the boiler. Among marine engineers the operation is more generally known as *scumming*.

Surface Car.—A passenger or other car; as, a horse or electric car, on a surface road.

Surface Carburetor.—In an internal combustion engine, a type of carburetor in which air is rapidly brought into surface contact with a "puddle" of gasoline

maintained by a float feed. Sometimes called *puddle carburetor*.

Surface Condensation.—In steam engineering, a system of condensing steam by cold metallic surfaces, in distinction to condensation by the injection of cold water.

Surface Condenser.—An apparatus for condensing steam, especially the exhaust of a steam engine, by bringing it into contact with metallic surfaces cooled on the other side by water or air; an oblong or circular metal box fitted with horizontal tubes; at each end are fixed the tube plates, generally made of brass, and the tubes pass through the plates as well as through a supporting plate in the middle of the condenser. Each end of the condenser is fitted with doors for the purpose of enabling the tube ends to be examined, drawn, or packed, as may be necessary. The tube ends are packed in various ways, and the tubes are made of brass, so as to resist the action of the water. The water is generally forced through the tubes by the circulating pump, and the steam is condensed by coming in contact with the external surface of the tubes.

Surface Conduction.—In physics, the rate of the loss of heat from a body, depending upon the condition of its surface, whether polished or dim.

Surface Current.—In hydraulics, a distinct current of superficial depth at the surface of a body of water.

Surface Gauge.—A machinist's instrument for testing the accuracy of planed surfaces. It consists of a block of metal with a vertical post or pillar to which is pivoted a scribe, the latter being pinched by a screw and adjustable at different heights. From its being used to scribe lines on work when the latter is marked off upon the surface plate, the tool is more generally known as a *scribing block*.

Surface Man.—In railways, a plate layer or trackman; one who maintains or repairs the track.

Surface Measure.—In mechanics, the measure of the exterior part of anything that has length and breadth; or the measure of one of the limits that bound a solid, especially the upper face:

MEASURES OF SURFACE.

144 square inches	= 1 square foot
9 square feet	= 1 square yard
30¼ square yards	= 1 square rod or perch
160 square rods or perches	= 1 acre
640 acres	= 1 square mile

Surface Planer.—A woodworking machine, in which the surface of a board, etc., is trued and smoothly planed by being run beneath a rotary cutter, the material traveling upon a smooth iron bed.

Surface Plate.—In machinist's work, a plate of metal which has been brought to the highest possible degree of superficial accuracy, and which is used for the purpose of testing the truth of work in course of preparation. They are made in several sizes, and rendered rigid with ribs underneath.

Surface Railway.—A street railway; a term used to denote one running on the ground level, as distinguished from a subway or an elevated road.

Surface Sizing.—In paper making, the process of adding gelatine size to the surface of writing papers. Also known as *tub sizing*.

Surfacing.—In shop practice, in turning, taking a cut across the lathe at right angles to its bed, by means of the cross-feed motion.

Surfacing Table.—In bricklaying, a table or bench on which gauged work is set out to test its accuracy.

Surge.—1. To rise and fall; as, a ship on the sea; to rise and roll, as do waves. In each sense the word conveys the idea of abrupt motion.

2. The curved swelling part of a capstan barrel or warping drum, upon which the rope *surges* or slips back.

3. To slip out rope as from a capstan, bitts, etc., to meet the motion of a moored vessel.

4. To slip back as a rope; thus, in hauling a vessel to her dock, the strain is kept on the taut rope, and if the ship does not move readily, a little slack is paid out, and then once more hauled in on the *surge*, usually effecting the desired motion.

Surge Reliever.—In navigation, a spring or spring tackle interposed between a cable and the windlass bitts or stoppers, to take off the suddenness of the jerks or surges on the chain. Also applied between a trace and a wagon.

Surround.—1. To enclose on all sides; to encompass; to environ.

2. To pass around; to travel about; to circumnavigate.

Survey.—1. To overlook, inspect, or make a comprehensive examination.

2. To measure distances with special instruments, angles, and levels, of portions of the earth's surface, with the object of determining *contours* and *areas*.

Surveying.—The operations by which are determined the form, dimensions, and levels of portions of the earth's surface,

and of the various works and structures permanently located thereon. Land surveying is more confined to the exact determination of boundaries and areas; marine surveying to ascertaining the contour of the sea bottom, its nature, and the configuration of the coast line, together with various dangers of the seas.

Surveying Cross.—In surveying, an instrument for establishing perpendicular lines. It consists of two pairs of sights at right angles to each other, on the arms of a cross which can be mounted on a *tripod* or single staff. The instrument is so adjusted that one pair of sights coincides with the base line, when the perpendicular line is set off from the other pair of sights.

Surveyor.—In civil engineering, one who views and examines for the purpose of ascertaining the condition, quantity, or quality of anything.

Surveyor's Chain.—A measuring appliance, for land surveying, made in different patterns, as:

1. *Gunter's chain*; this is 4 rods, 22 yards or 66 feet long = $\frac{1}{8}$ mile. It consists of 100 links, each link equaling 7.92 inches. Each tenth link is indicated by a brass tag; that for fifty links is circular and rather large, so as to be readily noticeable, the others are marked as follows from the center: 40 and 60 links four teeth on tag; 30 and 70 links, three teeth; 20 and 80 links, two teeth; 10 and 90 links, one tooth on tag. There are usually carried, with each chain, ten arrows for marking positions on the ground, each arrow being a pointed wire about 18 inches long, with a piece of red cloth tied to its ring.

2. *Ramsden's chain* of 100 feet long, each link being one foot in length.

3. *Décimètre chain* of 10 mètres long, each link being one décimètre or 3.93 inches. In most countries using the metric system, a chain of twice this length is generally employed, having a length of 20 mètres or 65.617 feet of 100 links, each measuring 7.874 inches.

Suspend.—To cease from operation or activity; to be unable to meet obligations or engagements.

Suspending Clutch.—A species of cramp or grapple to affix to the beams of a barn or warehouse for the purpose of suspending a block and tackle.

Suspension.—1. The act of suspending or causing to hang; as, a rope from one point to another.

2. Delay, holding over, postponement or interruption of any proceedings for a definite or indeterminate period.

3. In chemistry, the state in which undissolved particles of a solid body are held, floating in the bulk of a fluid.

Suspension Bridge.—In civil engineering, a bridge supported by chains, ropes, or wires, which usually pass over high piers or columns at each end, and are secured in the ground beyond.

Suspension Flue.—A type of corrugated boiler flue, in which the plain portions form a curve of suspension from one corrugation to the other.

Suspension Links.—In reversing engines, the rods or bars suspending the reversing links from the arms of the weight shaft; also known as *drag links*; *swag links*; *link lifters*; etc.

Suspension Railway.—A form of mono-rail road, in which the cars travel *underneath* the track upon which their wheels run. Such forms are convenient for transporting material within an area where it is desirable to leave the floor quite clear, the car being usually driven by an electric motor, which is controlled by an attendant sitting in the cage suspended from the trolley.

Sustain.—To keep from falling; to bear; to uphold; to support; as, a foundation sustains the superstructure; pillars sustain an edifice.

Suture.—The line along which two things or parts are sewed together, or are united so as to form a seam, or that which resembles a seam, as used in steam pipe coverings.

Swab.—A mop for cleaning floors, the decks of vessels, and the like.

Swab Pot.—In foundry, the vessel containing blackwash for sleeing the mould.

Swad.—1. A lump or mass; also, a crowd.
2. In coal mining, a thin layer of refuse at the bottom of a seam.

Swage.—A tool, variously shaped or grooved on the end or face, used by blacksmiths and other workers in metals, for shaping their work, whether in sheet metal or forging, by holding the tool upon it, or the work upon the tool, and striking with a sledge.

Swage Block.—A heavy block of cast iron, upon which the smith beats the heated plastic metal into the desired shape; it is perforated with numerous holes of different sizes and shapes for holding the material during upsetting, and has grooves around the edges to hold pieces being *swaged*.

Swage Nipple.—A short piece of pipe swaged down to a lesser diameter at one end, having a male thread at each end.

Swage Tools.—The grooved and furrowed tools between which a blacksmith draws down, smooths and finishes work; the *top swage* is held by the smith himself, the *bottom swage* fits in the *hardy hole* of the anvil.

Swaging Machine.—A power forging machine, fitted with a number of pairs of swages, each worked by a crank or eccentric. Dies of various shapes and sizes may be fitted to the swages, thus affording means for rapidly producing a number of uniform forgings.

Swamp.—Wet, spongy land; soft, low ground saturated with water, but not usually covered with it; marshy ground away from the seashore.

Swan Neck Tool.—In a machine shop, an ordinary side roughing tool, as used in a lathe, so called because it is frequently forged with considerable curvature to allow it to be worked close into the centers.

Swape or Sweep.—In hydraulics, a well sweep, or primitive device for drawing water from shallow wells. It consists of a pole, heavily weighted near its butt end, which is pivoted on an upright post or fork. The butt is lifted until the bucket, depending from the longer end, has entered the water and become filled; a little pressure on the counter-balance raises the bucket, which can be swung around, so as to be deposited anywhere within a circle whose radius is the length of the longer arm of the sweep.

Swarf.—The usual machine shop term for wrought iron or steel turnings and borings.

Swash Plate.—A revolving circular plate, set obliquely on its shaft, and acting as a cam, to give a reciprocating motion to a rod in a direction parallel to the shaft.

Swatch.—A piece, pattern, or sample, generally of cloth.

Sweating Furnace.—In metallurgy, a special style of furnace in which a *matte* of copper, lead, etc., is subjected to a sustained heat, to free the copper from the other metals.

Sweating On.—The soldering of metallic surfaces without the aid of a copper bit. The surfaces are cleaned, heated and covered with a film of solder; they are then brought into juxtaposition and warmed until the solder flows and unites. Sweating on is often employed for the temporary holding together of work which has to be turned or

shaped, and which could not be so conveniently held by other methods. After having been turned or shaped, the separation of the parts is readily effected by the aid of heat.

Sweat Rag.—An engine room term for a coarse, cotton towel, specially woven for use in polishing the bright work of machines. Also called *sponge cloth*.

Sweep.—1. In navigation, a large oar used to propel sailing vessels in calms, and worked by several men.

2. In founding, to work a loam mould up to the proper outline, by means of profile boards moved over it under mechanical guidance.

Sweeping.—1. Cleaning off surfaces, or clearing away dust, dirt, or litter, as a broom does.

2. Moving with swiftness and force, carrying everything before it.

Swell.—To extend the exterior surface or dimensions, by matter added within or by expansion of the enclosed substance; to grow larger.

Swell Piece.—A shop term for any flat piece of material which has its outer face curved.

Swift.—1. Moving over a great distance in a short time; moving with celerity or velocity; fleet; rapid; quick; speedy.

2. In civil engineering, the rapid current of a stream.

3. In manufacturing, a reel or turning instrument for winding yarn, thread, etc., used chiefly in the plural; as *swifts*.

4. In machinery, the main carding cylinder of a flax carding machine.

Swifter.—1. A rope encircling a boat to stiffen it, either parallel with the water line or on the sheer line.

2. A rope used to confine capstan bars in their sockets in the capstan head.

Swimming Tub.—In calico printing, a vessel containing the liquid color or mordant, covered by a floating fabric, on which the printing block is pressed to take up its color.

Swing.—1. To vibrate or oscillate to and fro in the same manner as a pendulum.

2. To move, revolve, or oscillate upon a fixed support, as said of a bridge, gate, boom, or derrick.

3. To move or float around, as a ship, either with wind and tide when at single anchor, or else by maneuvering of engines and rudder when desiring to turn around in confined spaces.

4. To cause to move in a vibratory or oscillating manner.

5. The dimensions of a piece of work which may be revolved between the centers of a given lathe. The term usually has reference to the diameter alone, and therefore, *the swing is twice the vertical height from the bed to the center*, lathe having this distance equal to ten inches is said to have a twenty swing. This use of the term is confined to the United States, lathe elsewhere being classified according to height of centers.

Swing Bolster.—In a locomotive, a cross beam or transverse piece of a truck which is connected with the truck by means of swinging links. The weight of the engine or tender rests upon the center plate in the bolster, and the interposition of links, instead of a rigid connection, relieves lateral strains due to weight.

Swing Brace.—An instrument for rotating hand drills, etc., operating by the swing of a crank which is formed in its stem.

Swing Bridge.—A bridge over a waterway having a span capable of revolving on a pivot, so as to afford a passage for vessels. A *drawbridge*.

Swing Check.—In hydraulics, a check or non-return valve for a pump delivery pipe, having a swinging flap, hinged on one edge and closing against an inclined seat. A *clack valve*.

Swing Frame.—In machine shop practice, the circular part of a tool rest, on a planing or shaping machine, which may be swung through an angle to take other than vertical or horizontal cuts; also known as *swivel head*.

Swinging Coupling.—In a locomotive, a pipe connection which permits a certain amount of lateral or vertical motion.

Swing Jack.—A type of screw jack with a swaying motion, used in connection with replacing derailed railway vehicles.

Swing Joint.—In pipe fitting, a coupling device consisting of two cone connections at right angles to each other, permitting a universal motion to the connected pipe; as, a gas bracket.

Swingle.—1. A wooden instrument like a large knife, about two feet long, with one thin edge, used for cleaning flax, called also *swinging knife*, *swinging staff*, and *swinging wand*.

2. To clean, as flax, by beating it with a swingle, so as to separate the coarse parts and the woody substance from it.

Swing Link.—In railway vehicles, one of the connecting links or hangers between a swing bolster and the truck frame. The links are not placed vertically but inclined towards a common central point, so that when the engine sways its weight tends to bring itself back into position again.

Swing Saw.—A sawing machine having a circular saw attached to the lower end of a swinging frame.

Swing Stock.—In flax dressing, an upright piece of timber over which flax is beaten and scraped with the *swingle*.

Switch.—1. In railway operation, to shift from one track to another; as, a car or train. A *flying switch* is an operation in which a train in motion is divided into two parts by disconnecting at some point, one part going forward on the main line, while the other is shunted on to a siding.

2. A movable rail to conduct traffic from one track to another. Also called a *point*.

Switching Engine.—A locomotive for switching cars from one track to another, and for making up trains.

Switchman.—An attendant at switches or points upon a railroad, to move them as required for the proper movement of trains.

Switch Point.—The point in a railroad switch which is thrown back and forth to determine the direction in which a train shall run; the movable end of a switch rail opposite to the track.

Switch Valve.—In steam engineering, a device for conducting exhaust steam into the smokestack or atmosphere. A *three way cock*.

Swivel.—1. A link or connection in a chain to permit twisting and prevent kinking; it consists of a stirrup shaped link in the cross piece of which a small eyebolt is free to revolve, although the end of its shank is riveted over or otherwise secured. Another pattern is a hook, whose shank is similarly secured within the stirrup.

2. A provision made by a pin and collar to permit circular motion as applied to numerous parts of machines, the joint turning upon the pin.

3. In gas fitting, a joint that will turn horizontally.

Swivel Apron.—The swiveling part of a toolbox for a planing or shaping machine; also called *swing frame*.

Swivel Hanger.—The ordinary ball and socket hanger for shafting. It derives

its name from its peculiar arrangement by which it turns with the varying motion of the shaft which it supports.

Swivel Head.—On shaping and planing machines, a mechanism for carrying the cutting tool, so constructed that the tool may be adjusted to any angle in a plane perpendicular to the direction of its motion.

Swivel Head Lathe.—A special lathe designed for boring and turning taper objects, the mandrel headstock being mounted on a base plate upon which it is pivoted. The base is firmly secured to the lathe bed, and the bolts which hold the head to it can move in radial and curved slots, permitting the head to swing through the desired angle, to which it is set by adjusting screws at the side.

Swiveling Tool Rest.—1. A tool rest pivoted on a central pin around which it may be swung to any convenient angle, as fitted to many brass finishers' lathes and the smaller patterns of engine lathes.

2. A tool rest which may be inclined at an angle, as in a *swing frame*.

Swivel Loom.—In weaving, a loom for weaving a number of ribbons simultaneously, being fitted with *swivels*, or little shuttles, holding shading or tinting silks, which are carried on the batten.

S Wrench.—A double-ended spanner curved like the letter **S** in order that a semi-inaccessible nut may be turned, in two stages by reversing, through a sufficiently wide angle so that the wrench may again engage the nut for further turning.

Sycamore.—1. The American button-wood tree.

2. The sycamore maplewood is very white and easily worked and takes a high polish. It is used in turning and carding work.

Syenite.—A rock having a structure much resembling granite, but containing no free quartz. The stone is hard and durable, of a fine grain and light gray color. The name is derived from Syene in upper Egypt, where rock was quarried to build the vast monuments of the ancient Egyptians.

Symbols.—Characters, letters or marks signifying some idea, process or substance, such as are employed in mathematics and in chemistry. Popularly, the marks used in mathematics (such as, +, −, =, etc.)

are termed *mathematical signs*, while the abbreviations of the names of the elements, such as, S, Mo, Pt, are known as *chemical symbols*. These are generally the initial and one significant letter of the name.

Symington, William.—Born 1763, died 1831. An English engineer and inventor. He took out a patent for an improved form of steam engine (1787) and mounting it on a pleasure boat, successfully propelled the boat; in 1802 he constructed the first practical steamboat, but the death of his patron soon after prevented him from carrying out his plans to a successful issue.

Symmetrical Load.—In architecture, said of a load which is regularly disposed with regard to the structure destined to bear it, one stress or part being similar in strength or intensity to the corresponding stress or part opposite to it.

Synchronous.—Simultaneous; to agree in time; motion of machinery arranged to correspond in time.

Synclinal.—1. In mechanics, inclined downward from opposite directions, so as to meet in a common point or line.

2. In surveying, formed by strata, dipping towards a common line or plane; as, a synclinal trough or valley.

Syndicate.—An association of persons officially authorized to undertake some duty or to negotiate some business; also, an association of persons who combine to carry out, on their own account, a financial or industrial project; as, a syndicate of bankers formed to take up and dispose of an entire issue of railroad bonds.

Synopsis.—An abridgment of any general subject; a compendium; abstract; a general view or a collection of heads or parts so arranged as to exhibit a general view of the whole.

Synthesis.—1. The putting together of two or more things to make a whole; the reverse of *analysis*, which signifies the resolution of a whole into its component parts.

2. In mental philosophy, logic, etc., the combining of separate elements or objects of thought into a single whole.

3. In chemistry, the building up of a compound by union of its constituent elements, such as the formation of water by burning oxygen and hydrogen together.

Syphon.—A bent pipe or tube with legs of unequal length, used for drawing liquid out of a vessel by causing it to rise within the tube, over the rim or top. The shorter leg is inserted in the vessel and the air exhausted from the longer leg, when the pressure of the atmosphere causes the liquid to fill the tube and run out of the lower end. This flow depends upon the difference in vertical height of the two columns of liquid, measured downwards from the bend, and ceases when they become of equal height or when the level in the vessel has fallen to the bottom of the shorter leg.

Syphon Cock.—In a steam gauge, a cock with which is combined a chamber in which a syphon is formed, this being kept partially filled with water of condensation so that steam may be prevented from entering and damaging the pressure gauge to which the cock is attached.

Syren.—In navigation, a sound producing instrument worked by steam and compressed air, consisting of a slotted cylinder or disc rotated rapidly at the base of a trumpet. It emits a piercing sound carrying a great distance and is used for a fog signal afloat and at lighthouses.

Syringe.—An instrument for forcing liquids, consisting of a tightly fitting piston working within a cylinder, one end of which is closed with a perforated cone, whose dimensions are suitable to the purpose of the syringe. On placing the cone in the water and lifting the piston, the atmospheric pressure drives the liquid into the cylinder; on pressing the piston back, the water is forced out in a jet through the orifice. The cone may be replaced by a perforated plate, which sprays the liquid over a large area.

System.—Regular method or order; as, to have a system in one's business.

Systematic.—Methodical; formed with regular connection and adaption or subordination of parts to each other, and to the design of the whole; as, a systematic course of study; a systematic arrangement of a power plant.



T.—The twentieth letter of the English alphabet.

Tab.—1. One of the revolving arms which lifts the beaters of a fulling mill.

2. A loop for lifting something.

Tabernacle.—In navigation, an elevated socket for a ship's mast, or a projecting post, to which a mast may be hinged when it is fitted for lowering, to pass beneath bridges.

Table.—1. In mechanics, that part of a machine or machine tool on which the material or work is placed for handling.

2. In mathematics, a series of numbers, values, measures, weights or units, arranged in tables to facilitate study or calculation; as, tables of contents, the multiplication table, etc.

3. Anything like a table in form.

Table Anvil.—A small anvil adapted to be screwed to a table, for bending plates of metal or wires, for making small repairs, etc.

Table Bit.—In wood working, a large spoon bit, used to make the holes in the upper parts of tables into which the legs fit.

Tabled Joint.—A masonry joint, in which part of the bed of one stone is let into the next course.

Table Lathe.—A small lathe attached by a clamp to a table and run by hand, or by a driving wheel in a movable frame.

Table Leaf Joint.—A peculiar form of furniture joint used in desk and table leaves, rules, and in some kinds of shutters. It has a moulded edge, forming a quarter round, the respective portions being hollow and swelling, so as to move on each other in manner of a knuckle joint. The pintle occupies the position of the axis of the curved surfaces. Also known as a *rule joint*.

Table Plane.—In joinery, a furniture maker's plane for making those joints on the flaps of tables and sideboards called *rule joints*.

Table Saw.—In tools, a short narrow saw, tapering towards the point, used for cutting sweeps and curves by hand.

Tablespoonful.—A term of measurement, where one common tablespoonful is equal to one-half fluid ounce.

Tablet.—1. In architecture, a coping on a wall or scarp.

2. A plate or slab for writing upon.

Table Vise.—In machinist's work, a small vise for light work attached to a table or bench by means of a screw underneath, which tightens up a triangular pointed clamp against the under side of the table.

Tabular.—Arranged in orderly fashion in lines and columns; as, with a list, schedule, synopsis or arithmetical table of numbers.

Tabulating Machine.—A machine so devised, that by working a keyboard, figures may be printed in tabulations.

Tabulator.—A device attached to typewriting machines, whereby figures may be automatically arranged in a tabular form, with rapidity and accuracy.

Tabulator Plunger.—A piston key attachment to a typewriting machine, which spaces the figures written down, so as to arrange them in the form of tables, the width of the columns being previously determined.

Tache.—In sugar refining, a pan in a battery of sugar pans.

Tachometer.—1. In hydraulics, a device to show the swiftness of a current by its effect upon a submerged paddle or paddle wheel; a current meter having a rotating screw for driving clockwork, indicating the speed in miles per hour.

2. An indicator, to show at a glance the speed of rotation.

3. A device for showing the changes in the velocity of machines, by the action of mercury in a revolving cup.

Tack.—1. The lower forward corner of a fore and aft sail, or the lower weather corner of a course or lower square sail.

2. The rope, by which the tack of a sail is drawn forward or confined.

3. To manœuvre a ship to port or starboard of her general course, so as to take advantage

of the wind, the vessel sailing close hauled with the wind on her starboard side when on the starboard tack, or with it on her port side when on the opposite tack.

4. A small, sharp pointed, flat headed nail, used as a fastening for carpet, plump, etc., or for securing labels and directions to packages. Dominated by their weight per 1000; as, 5 ounce, 8 ounce, etc.

Tack Claw.—In saddlery, etc., a bifurcated tool for drawing tacks. It is especially used by saddlers, trunk makers, and other leather workers.

Tack Hammer.—A light hammer, used for driving tacks; instead of a pene, it is usually furnished with a claw for drawing them. The head is often magnetized, to hold the tack.

Tackle.—1. The instruments, taken as a whole, for carrying on a work; tools; outfit; equipment.

2. A mechanical contrivance for obtaining a hold or purchase over anything, with a view to hoisting or moving it; as, the connection of two or more blocks and a rope.

3. In mining, a windlass with its gear for hoisting from small depths.

Tackle Board.—In rope making, a frame at the head of a ropewalk containing the *whirls* to which *yarns* are attached to be twisted into *strands*. The whirls are also known as *winches* or *forelock hooks*, and there are generally three in a tackle board, that being the number of strands which go to make a *rope*.

Tackle Hook.—The hook by which a tackle is connected to an object to be hoisted.

Tacky.—Sticky; adhesive; raw; said of paint, varnish, etc., when not well dried.

Tact.—Ready power of appreciating and doing what is required by circumstances; nice perception or discernment; peculiar skill or faculty; a winning mental power.

Tag.—1. A strip having means of attachment to a bag or package, on which an address may be written, printed or stamped.

2. A metallic binding on the end of a boot lace to stiffen and prevent raveling.

Tagliabue Test.—A method of observing the flash point of oils, named after its deviser. A standard cup of porcelain, holding the sample to be tested, is placed over a lamp or regulable flame, and a lighted taper is passed to and fro over the surface of the liquid, as its temperature rises, until the vapor ignites. A glass thermometer is suspended vertically, with its bulb in the oil, from a small gallows or support, which shows the temperature of ignition.

Tail.—1. A projecting rear part of anything; the part remote from the head; a part corresponding in appearance and position to the tail of an animal.

2. The handle, stem or stalk of a tool or implement; as, of a single ended spanner.

3. The lower end of a roofing slate or tile.

4. The rear end of a railway train.

5. The part on a crane projecting rearwards, on which the balance box is run in or out to counterbalance the weight lifted by the jib.

6. A rope fastened to a block for lashing the latter to any object.

7. The end of a masonry step, usually nine inches long, which is inserted into a wall.

Tail Block.—A wooden pulley block which is provided with a tail or line for lashing it to any object, instead of the becket or thimble generally provided.

Tailings.—In mining, the refuse material thrown aside after extraction of the metals, more especially that part of an ore, bearing precious metal, which is rejected as worthless after concentration and amalgamation.

Tail Lamp.—A signal light, exposed on the rear car of a railway train to warn following trains, or to notify signalmen as the train passes that it is intact. Also called *tail light*.

Tail Piece.—1. Anything affixed or placed as an appendage.

2. A small engraving placed at the end of a chapter to fill up blank space, or at the end of a book.

3. The lower part of the windbore or suction pipe of a mining pump.

Tail Pin.—In machine shop practice, the dead center or centers in the loose headstock of a lathe.

Tail Pipe.—The suction pipe of a pump. It communicates with the pump stock through a clack valve, and in the case of metal pumps is in two parts, the upper one of which has a screw thread at its lower end, by which it is secured to the lower part, the latter being cut to a suitable length.

Tailrace.—In hydraulics, the channel by which water runs away after driving a mill wheel or turbine.

Tail Rod.—In a steam engine, a prolongation of the piston rod of an engine, which passes through a stuffing box in the cylinder cover remote from the crank, its function being to steady the piston in the cylinder. On horizontal engines of

large size, a guide shoe is frequently placed on the tailrod, to support the weight of the piston.

Tail Shaft.—In a steamship, that end portion of the screw shafting on which the propeller is fixed.

Tail Sheave.—In mechanical engineering, the sheave over which the tailrope of a cableway runs.

Tail Spindle.—In a machine shop, the spindle carrying the dead center of a lathe; the *tailstock* or loose headstock spindle.

Tailstock.—The stock in which slides the dead spindle of a lathe, supporting the end of the work remote from the driving headstock.

Tail Valve.—In steam engineering, an air pump valve in one form of condenser, opened by the steam entering the condenser, but closed by atmospheric pressure when a partial vacuum exists in the condenser.

Tail Water.—In hydraulics, the waste water discharged from the buckets of a water wheel in motion.

Take.—1. To lay hold of; to seize with the hands or otherwise; to fix upon anything.

2. In printing, the quantity of copy given to a compositor at one time.

Take Up.—That which takes up or tightens, specially in machinery, a device to draw up the slack which has occurred through long or heavy usage; as, of belting.

Take Up Box.—In grain machinery, a device for taking up the slack on conveyer or elevator belts. It is made in various patterns, the principle in each case being a shifting bearing, for the shaft of a conveyer pulley, which can be moved to and fro in its frame by means of a screw, thus altering the tension of the belt.

Taking Up.—1. A shop term which signifies the making of adjustment for wear. It is nearly, though not quite, equivalent in meaning to tightening, but is rather applied to smooth bearing and moving parts, than to parts tightly bolted or wedged together. The term is applied to the closing up of strap ends of connecting rods, the cone bearings of lathes, divided brass bearings, compensating collars, etc. It is accomplished by means of set screws, gibs and cotters, lock nuts, etc.

2. In millwrighting and rigging, also applied to the shortening and relacing, or resplicing of belts and ropes which have become stretched by use. It is then termed *taking up slack*.

Taking Up Wear.—In mechanics, the operation of adjusting the bearings and other wearing parts of machinery so as to reduce the clearance or looseness occasioned by wearing away of the parts.

Talc.—A soft mineral of a soapy feel, usually found massive, the blocks being easily split into broad flat plates which differ from mica in being inelastic. There are various colors: white, apple green, dark green and yellow. Talc is used for glazing gas and oil stoves, for unbreakable lamp chimneys, and, when powdered, as a lubricant, a gloss for paper, or for a toilet powder.

Talk.—To utter words; to speak freely; as, in familiar discourse, when two or more persons confer together.

Tallow.—A substance composed of the harder and less fusible fats, obtained by rendering beef or mutton fat, as also almost any of the animal fats, and of certain vegetable fats.

Inferior kinds of animal tallow are known as "melted stuff," "rough stuff" and "town tallow." These are used in machinist's work for coating bright work to prevent corrosion. In lubrication, tallow should not be used unless of the very best quality, since with high pressure steam it becomes partially converted into oleic or stearic acids, which corrode the iron in the piston cylinders and steam joints.

Tallow Kettle.—A copper or brass kettle standing on a tray in a warm portion of the engine room, to keep tallow fluid for lubricating purposes.

Tallow Syringe.—A syringe having its nozzle threaded to connect with a cock at the water level of the boilers, and used to inject fluid tallow to prevent foaming or priming. Used with low pressure steam only.

Talon.—In architecture, a kind of moulding, concave at the bottom and convex at the top; usually called an *ogee*.

Talus.—In civil engineering, a slope: (1) of an embankment or earthwork; (2) of a wall having a battering face.

Talus Wall.—In masonry, a wall inclined on its face, either by decreasing its thickness toward the summit or by leaning it against a bank, as a *retaining* or *breast wall*.

Tamping.—1. Clay or similar material forced into a drill hole on top of an

explosive charge, to confine it and so increase its effect.

2. The act of applying tamping material.

Tan.—1. An abbreviation of the geometrical term *tangent*.

2. The bark of the oak, and some other trees, bruised and broken by a mill, for tanning hides; so called both before and after it has been used. Tan, or oak bark, after having been used in the process of tanning, is burned as fuel. The spent tan consists of the fibrous portion of the bark. Five parts of oak bark produce four parts of dry tan.

Tan Bark as a Fuel.—In steam engineering, tan bark can be burned upon common grates and in the ordinary furnace, by a mixture of bituminous screenings. One shovelful of screenings to four or five of bark will produce a more economical result than the tan bark separate, as the coal gives body to the fire and forms a hot clinker bed upon which the bark may rest without falling through the spaces in the grate bars. With the coal more air can be introduced to the furnace.

Tandem.—1. One after another.

2. The term originally meant two horses harnessed in line, a play on the Latin word, *tandem* = at length. As applied by engineers, it signifies that two or more pistons are attached to the same piston rod; a plan followed in designing large gas and steam engines.

Tandem Engine.—A compound steam engine having two or more steam cylinders in a line with each other and attached to the same piston rod.

Tang.—A projecting part of an object, by means of which it is secured to a handle, or to some other part; anything resembling a tongue in form or position; as, the part of a knife or fork which is inserted into the handle.

Tang Chisel.—In carpentry, a chisel having a tang, as distinguished from a socket chisel.

Tangent.—A right line which touches a curve, but which, when produced, does not cut it; applied also to a curve, or to a plane or curved surface, which touches another at a single point.

Tangent Balance.—A balance showing weight by the position of a beam that is extended to serve as a pointer on a graduated arc.

Tangential.—1. Of, pertaining to, or moving in the direction of a tangent.

2. The point at which a tangent to a plane cubic curve meets the curve again.

Tangential Force.—In physics, a force which acts so as to give a tendency to a revolving body to fly off in a tangent to its orbit.

Tangent of an Arc.—A term used in geometry; a line touching the circle in one extremity of the arc, and continued from thence to meet a line drawn through the center and the other extremity.

Tangent Screw.—The worm in spiral gearing is sometimes so called, as its thread is tangent to the circumference or pitch circle of the wheel.

Tangle.—To unite, or knit together confusedly; to interweave or interlock; as, threads, so as to make it difficult to unravel the knot.

Tangram.—A Chinese toy made by cutting a square of thin wood into seven pieces, which, by combination in various ways, may form a great number of different figures.

Tank.—A cistern constructed to hold liquids; usually made of iron, thinner than boiler plate and thicker than sheet iron. A graduated tank is one fitted with water gauges and indicating marks at different heights, between which the capacity of the tank is known.

Tankage.—A slaughterhouse term used to denote the residue obtained in clarifying refuse fats, etc.

Tank Boiler.—An expression applied to the various types of shell boilers, on account of their large water content, as compared with a water tube boiler.

Tank Coal Board.—In a locomotive, a hatch or gate composed of several boards, fitted into ways riveted to the legs of a tender tank. Its purpose is to retain the coal or to permit its passage in small quantities convenient for the fireman.

Tank Coal Gate.—A swinging gate, holding back the coal on a locomotive tender.

Tank Filling Hole.—In a locomotive, the manhole in the back of a tender tank, used for filling it with water, or to afford entrance for repairs, cleaning or inspection.

Tank Legs.—In a locomotive, the extension of a tender water tank along either side, enclosing a space for the reception of coal.

Tank Locomotive.—A self contained locomotive carrying its fuel and water on the same frame; generally used for short distance traffic or shunting.

Tanks.—Cisterns or receptacles for water and other liquids. In shape, they are usually either rectangular or cylindrical, although, for use on shipboard, they may be of any convenient irregular shape.

Tank Steamer.—A vessel specially built for the conveyance of petroleum and other liquid cargoes *in bulk*.

Tank Tender.—In railway engineering, a vehicle built of sheet steel, and provided with a large tank to hold water for the locomotive boiler.

Tank Valve.—In a locomotive, a valve, or more properly a cock, placed under the tender footplate at each leg, serving to control the admission of water into the gooseneck of the tender, and thence to the suction pipe.

Tan Liquor.—The ooze or leaches, solutions of tanbark, etc., in which skins are steeped during tanning processes.

Tannate of Soda.—A salt of tannic acid and the metal sodium, perhaps the best known and most reliable boiler anti-incrustation compound. It is sold in crystals or solutions.

Tannery.—A place where the art or process of tanning or leather dressing is carried on.

Tannic Acid.—A white, uncrystallizable substance, inodorous and very soluble in water, possessing a marked astringent taste. There are two commercial varieties, *gallotannic acid* from nut galls, and *quercitannic* from barks and leaves; it is also termed *tannin*. Tannic acid precipitates starch, albumen and gluten; it forms with gelatin an insoluble compound, which is the basis of leather, and upon which fact the whole art of tanning is founded. Gallotannic acid is used in medicine as an internal and external astringent and as a styptic.

Tannin.—A generic name given to many substances of vegetable origin, soluble in water, and possessing markedly astringent properties. Many give precipitates with gelatine, converting animal skins into leather. The chief sources of such

tannins are oak bark, sumach, hemlock bark, etc.

Tanning.—The process of impregnating the hides of animals with a solution of tannic acid, converting their gelatinous substance into a material that will not putrefy, and which may be either firm and hard or else soft and supple, according to the method employed. Hides are cured by sun drying, salting or the use of chemicals. After repeated washings, to remove the curing and restore their original softness, the skins are steeped in a solution of milk of lime, which causes them to swell or *plump*, and loosens the hair. The hide is placed on a sloping wooden block, the *tanner's beam*, and the hair removed by means of a blunt knife; after washing, the process is repeated, the fat, etc., being removed from the flesh side with a sharp knife. After trimming and soaking in weak acid, to neutralize the lime, the skin is placed in the *tan liquors*, beginning with weak solutions and being successively removed into pits containing stronger and stronger solutions. As soon as they are evenly colored, the hides are no longer suspended in the pits, but laid flat in bundles, later on being laid away for a lengthy period with tanning material placed between them. The operations enumerated occupy from two to twelve months, depending upon the thickness of the leather and the tanning agent employed. The leather is then removed from the pits, hung up and allowed to drip, scoured when half dry to remove dirt and tanning material, coated with oil, rolled to flatten it, and finally dried hanging in a heated shed. This completes the process for heavy sole leathers; softer goods require to be tanned in weaker liquors with more frequent handling, and, when tanned, are subjected to *currying* and *dressing*.

Tan Pit.—A sunken vat, in which skins are steeped in tanning liquor. Also called *tan vat*.

Tantalum.—A rare metal, resembling platinum in color, with a specific gravity of 16.5, and a melting point about 4100° Fahr. It is malleable, ductile, and very tenacious. When repeatedly heated and flattened to a plate, under a steam hammer, it becomes so hard that a diamond will not bore it. It offers very little resistance to the electric current, and so, in view of its high melting point, it is used as a filament in incandescent lamps.

Tap.—1. To strike with something small, or to strike with a gentle blow.

2. A conical screw made of hardened steel, and grooved longitudinally, for cutting threads in nuts, and the like; as, in a *tap and die*.

Tap Bolt.—A bolt with a head on one end and a thread on the other end, fitted to be screwed into some fixed part at one end, and to receive a nut at the other.

Tap Borer.—A boring instrument, shaped like the half of a hollow cone, used by coopers for making bung or tap holes in casks, or by plumbers for making or enlarging holes in leaden pipes.

Tap Cinder.—In a furnace, the slag from previous puddling operations which is put into the ball furnace with the charge of pig iron. It covers the molten mass to prevent its rapid oxidation, and assists to absorb the waste carbon and silicon.

Tape Line.—A painted tape, marked with inches, etc., and enclosed in a case, used by engineers and others in measuring.

Taper.—1. Having a non-cylindrical form, the diameter uniformly diminishing as the measurement recedes from the largest part. Conical, or drawing to a point.

2. To form into a conical, pointed or non-cylindrical shape.

3. To diminish to a point; to dwindle away.

4. A long wick coated with wax for igniting other illuminants; a small wax candle.

Taper Attachment.—In machine shops, a device attached to a turning lathe so that conical turning may be effected. A usual pattern is a bar at the back of the lathe bed, the cross-slide of the lathe engaging with this bar, and thus moving nearer or further from the center as it travels along the bed, according to the inclination given to the bar.

Taper Bolt.—In mechanics, it is customary to make bolts for securing locomotive cylinders to their frames, coupling bolts for marine engines, etc., with a taper of $\frac{1}{16}$ inch per foot, so that the bolts may be driven tightly home. The works making locomotives usually have bolt turning lathes set to this uniform taper.

Taper Drill.—A long taper reamer or fluted cutter for forming conical holes under a drilling machine. A long *countersink*.

Taper Pin.—A conical dowel, fitting in a suitably shaped hole formed in two pieces of work, securing them together. The Pratt and Whitney standard of taper is $\frac{1}{4}$ inch per foot, their pins being made in ten sizes, from $\frac{5}{16}$ in. to $1\frac{1}{16}$ in.

Taper Reamer.—One designed to enlarge tapered holes; they are usually made to suit one of the standard tapers, either for taper pins, twist drills, or the cock taper.

Taper Tap.—The first or entering tap of the three which constitute a set for the formation of internal threads. It is generally a straight taper from a diameter below that of the tapping hole up nearly

to the finished size. *Gas taper taps* are usually over size at the large part of the taper.

Tapestry.—In weaving, a fabric, usually of worsted, worked upon a warp of linen or other thread by hand. A term applied to different kinds of embroidery.

Tap Hole.—1. In founding, the opening in the breast of a furnace or cupola through which the molten metal flows. It is closed by *botting*.

2. In smelting furnaces, the hole through which the refined molten metal is drawn off.

Tappet.—A device, consisting of a lever and contact pieces, whereby a tappet valve is actuated, as in single cylinder steam pumps. It makes the connection between the driving mechanism and the valve.

Tappet Motion.—In machinery, the feed motion derived from the action of a *tappet*, as distinguished from that of a *pawl* or other agency.

Tappet Valve.—1. A disc or mushroom valve operated by some device with which it is not positively connected; as, a cam or trip lever. The valves of an internal combustion engine are generally of this type.

2. A valve moved on its seat by means of a tap or blow from some other part of the mechanism. The slide valves of a single cylinder steam pump are usually of this description.

Tapping.—1. The operation of drawing off liquids from a vessel, or molten metal from a furnace.

2. The operation of making an internal thread by means of taps.

Tapping Bar.—A foundry tool, consisting of a long steel rod with a wedge or pricker point used to remove the *bot* or plug from the tap hole of a cupola.

Tap Wrench.—A key or spanner to operate a tap for threading holes. The usual pattern has a handle on either side of the socket for the square on the tap shank.

Tar.—1. A very dark, oily liquid obtained in the process of distillation of various substances; that resulting from the distillation of resinous woods, which is used as a paint, a preservative of cordage, etc.; the product derived from gas manufacture, coke ovens, or other distillation of coal.

2. The residuum of petroleum left after the kerosenes or illuminating oils have been distilled off; the extent or nature of the residue depends upon the locality or the refined product demanded.

Tar Board.—A strong quality of mill-board made from junk and old tarred rope.

Tare.—An allowance made to a purchaser of merchandise, by deducting from the gross weight, the weight of the box, cask or sack in which the goods are packed.

Tare and Tret.—In arithmetic, a rule or process for calculating the *tare* on goods, and similar allowances.

Target.—In surveying, the disc which slides up and down the transit rod. It is generally painted one half white and the other half or upper part red, the dividing line of the two colors coming in the exact center.

Tariff.—A schedule, system or scheme of duties imposed by a government of a country upon goods imported or exported.

Tar Lamp.—A lamp for burning tar for purposes of illumination.

Tarnish.—To soil or sully; more especially to become dimmed or stained; as, certain polished metals by action of moisture, sulphureted hydrogen or other gases in the atmosphere.

Tarpaulin.—1. A canvas sheet, covered with tar or a composition to render it waterproof, used for covering the hatches of a ship, hammocks, boats, and the like.
2. A hat covered with painted or tarred cloth, worn by sailors and others.

Tarred Ropes.—In rigging, ropes made of hemp, usually Russian, and steeped in tar, to prolong their life, as distinguished from manila or *white* ropes. The process reduces their strength.

Tar Varnish.—In hydraulics, a protective coating used for pipes and structures which are laid under water. It is variously made, but is composed essentially of the bituminous products of coal mixed with mineral oils. One method is to mix 30 gallons of tar (coal) fresh with all its naphtha retained, 6 lbs. of tallow, 1½ lbs. of resin, 3 lbs. of lamp-black, 30 lbs. of fresh slaked lime, finely sifted; mix and immediately apply hot.

Taste.—One of the five senses; the sense by which certain properties of bodies, called their taste, savor, flavor, are ascertained by contact with the organs of taste.

Taw.—To dress and prepare, as the skins of sheep, lambs, goats and kids, for gloves, and the like, by imbuing them with alum, salt, and other agents, for softening and bleaching them.

Tawery.—A place where skins are *tawed*.

Tawing.—The preparation of soft white leathers for gloves, military accoutrements, whip thongs, etc., by the use of alum or other minerals as a tanning agent instead of vegetable extracts. The skins are soaked and limed as for ordinary leather, and are then *pured* or soaked in a fermenting solution, being subsequently *drenched* or cleansed in a solution of fermenting bran. The skins are then placed in revolving drums, with a paste made of alum, salt, flour and yolk of egg, this paste penetrating the skin and transforming into a tough white leather. On removal from the drums, the leather is dried and laid by for a time to age, being next dampened with water and stretched over a blunt knife. After a second drumming, drying and stretching, the skins are *stuffed* or ground on an emery wheel to a uniform thickness, dyed and glazed.

Tax.—A charge, especially, a pecuniary burden which is imposed by authority; the sum laid upon specific things; as, a *land tax*; a charge or burden laid upon persons or property for the support of a government.

T Bar Iron.—An abbreviation for Tee bar iron. The letter indicates the sectional view of a bar of iron.

Teacupful.—A term of measurement where a small teacupful equals one gill, or 4 fluid ounces.

Teagle.—A corruption of tackle. A name applied to an apparatus for hoisting men and material to the upper stories of factories. A *man engine*.

Teak.—In timber, there are two woods thus designated, the one the African oak, the other the Moulmein or Indian, the latter the true teak. It is of a greasy nature and therefore does not corrode iron in contact with it. It contains silicious matter which dulls the edge of cutting tools. It is of a light brown color, shrinks little, is durable, straight and rather open grained, stands heat well, and is not attacked by insects. A cubic foot weighs 46 lbs.

Teaming.—1. In steel manufacturing, the operation of pouring the molten cast steel from the crucible into the ingot mould.

2. In civil engineering, the operation of transporting earth from the cutting to the embankment.

3. A certain mode of manufacturing work, which is given out to a boss, who hires a gang or *team* to do it, and is responsible to the owner of the stock.

Team Shovel.—An earth scraper. A scoop drawn by horses or oxen, managed by means of handles, and used in removing earth; as, on an excavation.

Teasel.—1. A plant which bears a large burr or flower head covered with stiff, prickly, hooked awns, or bracts, which, when dried, are used for raising a nap on woolen cloth.

2. To subject, as woolen cloth, to the action of teasels, or that which has an effect to raise a nap. Same as *teazel*.

Teasel Frame.—A frame or set of iron bars in which teasel heads are fixed for carding woolen cloth.

Tease Tenon.—In carpentry, one on the summit of a post, to receive two beams meeting each other at right angles.

Teat.—In machinery, a small protuberance or nozzle, resembling the teat of an animal.

Teat Drill.—A flat drill with a cylindrical guiding point; the same as *tit drill*.

Teazer.—In glass making, the hole through which fuel is supplied to the glass furnace.

Teazing Machine.—A machine for disintegrating woven fabric to make fiber for reworking. It usually consists of a cylinder with sharp pointed teeth that seize the fabric close to the feeding rollers, and tear and deliver it into a receptacle.

Technical.—1. Of or pertaining to the study or systematic knowledge of any industrial art or the like.

2. Appertaining to the practice or actual employment of any mechanical art rather than the theory or underlying principles by which it is governed.

Technology.—Industrial science, the science or systematic knowledge of the industrial arts; as, spinning, weaving, metallurgy, etc. It is not an independent science, having a set of doctrines of its own, but consists of applications of the principles established in the various physical sciences: chemistry, mechanics, mineralogy, etc., to manufacturing processes.

Tee.—In pipe fitting, a term or abbreviation for a branch pipe; the branch comes out of the main pipe at right angles, similar to a letter T. These pipes are often made with socket and spigot.

Teem.—A word used in two opposite senses: (a) to *fill*, or be filled as full as possible: (b) to *pour out*, more especially in great volumes.

Teeth.—1. The plural of tooth. It signifies a row of wires, prongs, or projecting pieces, which have various forms and duties in different tools, implements, and machines; as, the teeth of a saw, file, etc.

2. The wires of a carding machine or *curry card*.

Telautograph.—A writing or copying telegraph for reproducing writing or drawings at a distance, by means of a receiving pen, which, directed by a complex mechanism, that is under control of electric currents, follows the motions of a transmitting pin operated at the station of the sender. This was one of the inventions of Elisha Gray, of Highland Park, Ill.

Telegraph.—In navigation, an apparatus for transmitting orders from a ship's bridge to the engine room, poop, fore-castle head or elsewhere. A series of endless chains passing over pulleys in the machines at either place, cause the pointer on one dial to assume a position corresponding to that on the dial whence the signal has been transmitted; a gong calls attention to the movement of the telegraph pointer. For small craft, torpedo boats, etc., the endless chains are replaced by *tubular rods* rotated by sector gearing.

Telegraphic Codes.—Cipher systems, used in telegraphy for the sake of economy and secrecy. No cipher word may exceed ten letters, nor may it be a nonsensical or made up word, but one taken from civilized languages. Codes may be arbitrary or selective. In the former case, one word means a definite phrase or term, according to the vocabulary of the parties interested. With the latter, each word is regarded as a numeral of six to ten figures; each two figures represent a definite idea according to their position, the combinations being apparently numberless, yet easily translatable with the proper key. As an example, a message containing 144 code words, when translated, occupied 75 foolscap pages of typewritten matter.

Telegraph Valve.—A valve operated from some distance, by means of a cord passing round the hand wheel as a pulley. Same as a *telegraph cock*.

Telemeter.—An instrument used for measuring the distance of an object from an observer.

Telephone.—An instrument for reproducing sounds, especially articulate speech at a distance.

Telescope.—An optical instrument which magnifies the appearance of distant objects, causing them apparently to come nearer. It consists essentially of a tube containing the *objective*, a large converging lens or concave mirror (speculum) and a small *lens* or combination of lenses. The first forms an optical image of the object observed, and the latter magnifies the image.

Telescopic Pipe Joint.—A fitting consisting of a slip joint, in which the end of one pipe is free to move within end of another, the joint being kept tight by means of a gland and stuffing box. The telescopic joint permits longitudinal expansion and contraction.

Telescoping.—A term applied to a railway accident where cars are pushed into one another, in a manner grimly suggestive of shutting the draws of a telescope.

Telford, Thomas.—Born 1757, died 1834. A Scottish civil engineer. He was employed for many years upon important public works in Great Britain, building bridges, constructing canals and laying out roads. One of the most conspicuous of his achievements was the building of the Caledonian Canal. He constructed 1000 miles of roads and 120 bridges in Scotland, and improved many harbors; he superintended the construction of the Göta Canal in Sweden, connecting the Baltic with the North Sea (1808-10); built the Menai Suspension Bridge (1819) and developed a system of road building which bears his name.

Telltale.—In hoisting engines, an indicator by which the attendant of a winding engine is informed when to stop its motion, and so arrest the upward or downward movements of the cage. Telltales are employed also on various automatic machines, to indicate the precise time when a certain set of operations is terminated.

Telluride.—In chemistry, a compound of tellurium with a more positive element or radical; also called *telluret*.

Tellurium.—A white lustrous metal or metalloid, closely resembling sulphur and selenium in its chemical reactions; it has a specific gravity of 6.2, and melts at 845° Fahr.; it occurs native, but is more frequently found in combination.

Telpherage.—A system of electrical transportation over rough country. A rod or wire is suspended on insulated supports, and on it travels a small under hung electric locomotive or trolley, deriving its motive power from the rail; the motor trolley hauls similar two

wheeled trolleys, from which depend baskets or *skips* for the material to be transported.

Temper.—1. The state of hardness, or elastic condition imparted to steel by the processes of heating and quenching, after the preliminary hardening effected by bringing to a cherry red and suddenly cooling.

2. A classification of tool steel by the makers, depending almost entirely upon the percentage of carbon in the metal; as, *razor temper*, *saw-file temper*, *chisel temper*.

3. A mixture of two parts tin and one part copper, used by pewterers or by other metal mixers, to assist in the compounding of those alloys in which the percentage of copper is so small, that, if added alone, its high melting point would prohibit proper combination.

4. Milk of lime, etc., added to boiling syrup to clarify it.

Temperate Zone.—In geography, that part of the earth which lies between either tropics and the corresponding polar circle; so called, because the heat is less than in the torrid zone, and the cold less than in the frigid zones.

Temperature.—1. That which determines the heat or coldness of anything. A relative term denoting the heat of anything as compared with that of a standard, the temperature being measured by the number of graduations upon a thermometric scale.

2. The sensible heat in anything, the measurement of which is made by the thermometer.

3. The luminosity of shades of temperature have been observed by means of an air pyrometer, to be as follows:

SHADE.	TEMPERATURE. Fahrenheit.
Nascent Red.....	977°
Dark Red.....	1292
Nascent Cherry Red.....	1472
Cherry Red.....	1652
Bright Cherry Red.....	1832
Very Deep Orange.....	2012
Bright Orange.....	2192
White.....	2372
"Sweating" White.....	2552
Dazzling White.....	2732

A bright bar of iron, slowly heated in contact with air, assumes the following tints at annexed temperatures:

	Fahrenheit.
1. Cold iron at about.....	54°
2. Yellow at.....	437
3. Orange at.....	478
4. Red at.....	509
5. Violet at.....	531
6. Indigo at.....	550
7. Blue at.....	559
8. Green at.....	630
9. Oxide Gray at.....	752

Temperature at which men can work.

—In a recent trial of a government steamer, the men worked willingly in a temperature of 175°, which however, rose to 212°, or the heat of boiling water. The shifts of four hours were reduced to two hours each, but after sixteen men had been prostrated, the whole force of thirty-six men refused to submit to the heat any longer and the trial was abandoned.

Temperature of a Furnace Fire.—In steam engineering, a method of finding the furnace heat, is by submitting a small portion of a particular metal to the heat, thus :

Tin melts at.....	442° F.
Lead " ".....	617° F.
Zinc " ".....	700° F. nearly.
Antimony melts at.....	810 to 1,150° F.
Silver melts at.....	1,832 to 1,873° F.
Cast Iron melts at.....	2,000° F. nearly.
Steel melts at.....	2,500° F.
Wrought Iron melts at.....	2,700° F. "
Hammered Iron melts at.....	2,900° F. "

Temperature of Space.—The temperature that would be experienced outside of the earth's atmosphere by an object shaded from the sun; estimated at about 200° below zero, Fahr.

Tempered Glass.—Glass hardened while in a hot state by immersion in a bath of oils, grease, wax or resin, whose temperature is above that of boiling water. Tempered glass will stand great heat, and is twice as strong as ordinary glass. When broken or cut with a diamond, it disintegrates and falls into little pieces, but may be etched with hydrofluoric acid or the sand blast.

Tempering.—The process of mixing materials together in their proper proportions, with a due amount of water to produce the required plasticity. Sand and lime are *tempered* to make mortar; clay is tempered with water to render it fit for pottery or brickmaking. The incorporation of flour and water into dough is also termed tempering.

Tempering Tool Steel.—The treatment to which tool steel is subjected, to ensure the proper hardness and toughness for a desired purpose. After hardening, the tool is reheated, and as its temperature rises, colors appear upon its polished surface; these colors, due to films of oxides, pass from very pale yellow through brown to blue and purple, the steel being quenched in brine or cold water as the desired color appears. Microscopic investigation explains the phenomena attending the process. Steel consists of various manifestations of the same substances, rather than separate compounds.

Template.—In structural iron works, any temporary pattern, guide or model, by which work is either marked out, or by which its accuracy is checked; usually thin light plates of wood or metal cut to special outlines.

Template Board.—A gauge, pattern, or mould, commonly a thin board, used as a guide to the form of the work to be executed.

Temple.—In weaving, an instrument for keeping cloth in its proper breadth, while the reed beats up against it in the process of weaving. In a loom weaving 100 picks per inch, the vibration of the reed being four inches, the reed passes over each portion of the warp threads 800 times. If, therefore, the cloth be not extended so as to bring the warps nearly parallel to the motion of the reed, the selvage threads become chafed. To obviate this difficulty, the temple is designed.

Templet.—In architecture, a plate of iron placed in a wall under a girder or other beam, to distribute the weight or pressure.

Ten.—One more than nine; twice five. It is often used, indefinitely, for *several*, *many*, and other like words.

Tenacity.—In physics, the attraction which the molecules of a material have for each other, giving them the power to resist tearing apart. The strength with which any material opposes rupture, or its *tensile strength*.

Tend.—1. To have or give a leaning; to aid; to move in a certain direction.

2. To accompany as an assistant or protector; to watch; to guard; to care for the wants of; to look after.

Tender.—1. One who or that which attends or looks after.

2. A person in charge of a machine, engine, boiler, etc.

3. A small vessel attending upon a larger one to transfer mails or passengers, to save delays through shallow water, tides, etc.

4. A supply vessel conveying stores, etc., to lighthouses or other isolated stations.

5. A vehicle constructed to follow and be attached to a railway locomotive, bearing the latter's supply of fuel and water.

Tender Axle.—In a locomotive, the wrought iron or steel shaft to which the carrying wheels of a tender are attached.

Tender Buffer.—A steel or iron casting, provided with springs to absorb shocks and blows; it is fitted to the rear end of a locomotive tender, and is placed above the central coupling, and serves as a footstep.

Tender Chafing Iron.—In a locomotive, a doubling plate fastened to the front end of a tender frame, so that it is in contact with a corresponding piece upon the engine frame.

Tender Frame.—A framework of channels or H beams, serving as underbody for a locomotive tender, having longitudinal or central sills to transmit the thrust and pull of the draw gear, and transverse bolsters for the trucks.

Tender Tank.—The receptacle provided for feedwater on the tender.

Tender Truck.—A four wheeled truck, of which there are two, used to carry a locomotive tender. On some narrow gauge railways with sharp curves, the tender has two rigid axles and a rear pony truck. The usual English and continental practice is to use three rigid axles for the tender.

Tenfold.—Ten times as many; in a tenfold manner or degree, so as to be in tens.

Tenon.—In carpentry, the projecting end of a piece of timber fitted for insertion into a *mortise*, formed by cutting away a portion on one or more sides; sometimes made round; the usual joint in putting up wooden frames, whether of buildings or machines.

Tenoning Machine.—A woodworking machine with four cutter heads, for forming accurate tenons.

Tenon Joint.—A woodwork joint, in which the tenon on the one part fits into the mortise on the other. The joints are secured either by a pin or by a dovetail, a wedge or backing piece being driven in to force the tenon against the undercut mortise.

Tenon Saw.—A woodworker's handsaw, having its blade stiffened by a steel or brass back piece, to secure accurate sawing; as, in cutting tenons, miters, etc.

Tenpenny Nails.—Penny in mechanics is a term denoting pounds weight for one thousand of the objects under consideration; as, in the case of *nails* of which one thousand weigh ten pounds, whence they are called tenpenny nails to indicate their *size*.

Tensile Strength.—The cohesive power by which a material resists an attempt to pull it apart in the direction of its fibers, this bears no relation to its capacity to resist compression.

Tensile Stress.—Force, which steadily and slowly applied in a line with the axis of a test piece, just overcomes the cohesion of the particles, and pulls it into separate parts.

Tension.—1. The degree of stretching to which a wire, cord, piece of timber, or the like, is strained by drawing it in the direction of its length; strain.

2. The force by which a bow or string is pulled when forming part of any system in equilibrium or in motion; as, the tension of a string supporting a weight equals that weight.

3. Expansive force; the force with which the particles of a body, as a gas, tend to recede from each other and occupy a larger space; elastic force; as, the tension of vapor; the tension of air.

4. In a sewing machine, a pressure upon the thread to prevent its running too easily from the spool. By adjustment of the pressure at the tension device, the required tightness of stitch is obtained.

Tension Carriage.—In power transmission, a frame sliding within rails, carrying a grooved pulley. The pull of a weight keeps taut the rope encircling the pulley, thus maintaining the tension in which manifold turns of a single rope are employed.

Tension Rod.—A stay or tie rod in a truss or structure, which connects opposite parts and prevents their spreading apart.

Tent.—1. In surgery, a probe for searching a wound: a roll of lint or linen, or a conical or cylindrical piece of sponge or other absorbent, used chiefly to dilate a natural channel to keep open the orifice of a wound, or to absorb discharges.

2. A pavilion or portable lodge, consisting of canvas or some strong cloth stretched and sustained by poles.

Tentation.—The act or process of adjusting by repeated attempts or experiments, until a desired effect is secured, as in the arrangement of complicated machinery.

Tenter.—1. One who takes care of or tends machines in a factory; a kind of assistant foreman.

2. A machine or frame for stretching cloth, by means of hooks called tenter hooks, so that it may dry even and square.

Tenter Bar.—In textile manufactures, a bar provided with a number of tenter hooks which are inserted in the selvedge of the cloth for the purpose of stretching it by pulling.

Tenter Hook.—In weaving, one of a set of hooks arranged on the inside margin of a frame used in stretching cloth, the margin of which is held fast by the hooks.

Tenth.—Next in order after the ninth; coming after nine others.

Tenuity.—Thinness, applied to a broad substance; slenderness, applied to anything that is long; as, the tenuity of a copper wire.

Ten Wheel Locomotive.—A serviceable and reliable type of locomotive good alike for freight or passenger service, being able to manage all but the very heaviest of the former or the very fastest of the latter. It has a four wheeled leading truck, and six coupled driving wheels.

Tepid.—Moderately warm; lukewarm; a term used in steam, and in water heating.

Teredo.—A shipworm; a mollusk; or bivalve shell. It peculiarly affects submerged woodwork, either stationary or floating, and is capable of doing great damage.

Terminal.—1. Applying to the end of anything.

2. The end of a railway system.

3. The starting or finishing point of a transit by rail, either with passenger or freight traffic; in this sense, with regard to charges and operations.

4. An architectural feature, consisting of a bust, of a man, woman or satyr, tapering into its pedestal, which is shaped like an inverted obelisk.

Terminal Pressure.—In steam engineering, that pressure which would exist in a steam engine cylinder, in expansive working, if the expansion were continued to the end of the stroke instead of being interrupted, as it is in practice, by *pre-release*. It is used in making calculations.

Terms of a Proportion.—In arithmetic, the four numbers of which the rule of three is composed.

Terms of a Ratio.—In arithmetic, the two quantities or magnitudes of a proportion compared. A proportion is an equality of ratios, as ratio is the measure of the relations of two like quantities. The equality is generally indicated by writing: between the ratios; thus, 8:2::16:4 indicates a proportion and is read, 8 is to 2, as 16 is to 4.

Tern.—1. A boundary or limit, the extremity of any thing.

2. A limited period; a definite space of time during which something lasts, runs its course or is intended to continue.

3. That by which a thought is given expression.

4. A member of a compound expression in algebra or arithmetic; a part of an expression joined to the remainder by a plus or minus sign.

Terne.—Sheet iron or steel, coated with a lead and tin alloy; roofing tin.

Terne Plate.—A sheet or plate of iron or steel, coated with an alloy of lead and tin in the proportion of $\frac{2}{3}$ lead and $\frac{1}{3}$ tin, it is the union of these three metals, iron, lead and tin, that gave rise to the word *terne* plate. The word "*terne*" is probably derived from the Latin "*terni*," meaning by threes.

Terra.—The earth; earth; a word transferred from the Latin language.

Terra Alba.—White earth; pipe clay; the name is also applied to other materials, as calcined or powdered gypsum.

Terrace.—1. A raised level space, shelf, or platform, having one or more sloping sides, supported by masonry, a bank of turf, or the like.

2. A raised level supporting a row of houses.

Terra Cotta.—1. In architecture, a compound of pure clay, colorless sand and pulverized potsherds, as moulded, dried in the air, and baked in a kiln, and thus is harder than bricks or tiles and said to be more durable than most stone.

2. Unglazed pottery.

Terra Firma.—In navigation, dry land; mainland, as opposed to islands.

Terrases.—In masonry, hollow defects or fissures in stone work filled with nodules of other substances. After being cleaned out, mastic is put in the hole to fill it out with the same color and appearance.

Terre Verte.—An olive earth used as a paint.

Tertiary.—1. In mathematics, containing a third part.

2. In geology, the first period of the age of mammals; called also the *tertiary period*.

Tessellated.—Formed of little squares, as mosaic work; as, a *tessellated pavement*.

Tessellated Plates.—In iron works, a term applied to the thin wrought iron checkered plates, used as foot plates, the word having reference to the form of the checkering, which is produced by the diagonal crossing of shallow ridges or elevations on the surface of the plate.

Test.—1. Originally the word meant an earthen pot, in which metals were tried; hence, by extension, to try by fire; as, in a test, or to submit to any critical trial or examination; the act or process of such a trial.

2. A cupel or cupelling hearth in which precious metals are melted for trial and refinement.

3. That with which anything is compared for proof of its genuineness; a touch stone; a standard.

Testacious.—Of or pertaining to shells; consisting of a hard shell, or having a hard shell; as, an oyster.

Test Bar.—In founding, a bar cast from the metal poured to make a certain casting. It is usually 2' x 1" x 3' 6", and is placed edgewise upon supports at 3 feet centers and loaded until it breaks. A bad bar will break at 2800 lbs., a fair average one from 3300 to 3400, and specially good ones will stand 4000 lbs. Tough bars will deflect $\frac{1}{4}$ inch before breaking in two.

Test Bottle.—In chemistry, a glass bottle, generally marked for measuring its contents, and provided with a ground glass stopper or cork, used to hold liquids while undergoing chemical tests.

Test Cocks.—In steam engineering, the cocks screwed into a boiler shell at the extreme highest and lowest water marks. They are used to check the water gauge itself in the event of the latter ceasing to act; the upper one being the *steam*, the lower the *water cock*. Usually three cocks are provided, one being placed halfway between the upper and lower cocks. Also called *gauge cocks*.

Test Diagram.—In mechanics, a diagram traced by a pencil connected with the actual test piece in a testing machine, thus showing the actual stresses upon, and corresponding motions within, the piece under trial. Useful for showing the *behavior* of the metal, and determining the yield point or elastic limit.

Tester.—A narrow blade of thin steel used to gauge the fit of two pieces of work. Several blades, each of a definite thickness, are often combined in a handle like a pocket knife, so that by combinations

or singly, a considerable range of measurements may be tested. Also known as *feeler*.

Testimonial.—A writing or certificate which bears testimony in favor of one's character, good conduct, ability, etc., or the value of a thing.

Testimony.—A solemn declaration or affirmation made for the purpose of establishing or proving some fact.

Testing.—1. In mechanics, the act or process of determining the strength of materials, and their behavior under strains of various kinds; as, elongation, bending, crushing, etc.

2. In metallurgy, the operation of refining gold or silver in a test or cupel; cupellation.

Testing Bench.—A bench fitted with steam, water or other pipes having connections at regular intervals, and provided with mountings whereon small steam or explosion engines may be run after assembling, to see that all parts are in good order. Means are also provided for ascertaining efficiency, by means of dynamometers, brakes, etc.

Testing Machine.—An application of the principles of the balance or steelyard for testing the strength of materials. Pieces of approved and standard size and shape, are firmly held in the jaws of the machine and the weights are applied through a system of compound levers working on knife edges. Modifications are made for compressive tests, or for proving chain cables.

Test Paper.—A paper prepared by dipping into a solution or decoction of a substance and drying; to be used to detect the presence of a substance whose presence causes a reaction, and a change in the color of the paper, as *blue litmus paper* changes to *red* by presence of an acid.

Test Specimens.—In iron works, pieces of materials specially prepared for testing, either with or without the aid of a machine.

Test Strips.—In specifications for boiler or other works in wrought iron and steel plates, it is usual to stipulate that a strip shall be cut off each plate and subjected to suitable tests by the engineer or inspector.

Test Tube.—In chemistry, a cylindrical vessel of thin glass, having one end closed, and sometimes provided with a foot, in which liquids are contained while subjected to tests.

Tetrahedron.—A geometrical figure bounded by four equilateral triangles.

Tew.—1. To prepare by beating or working; as, leather or hemp; to taw.

2. To work hard.

3. To tow along; as, a vessel.

4. A rope or chain for towing a boat.

Tewing Beetle.—A spade shaped beetle or hammer used in tewing or beating hemp.

Text.—A style of writing in large character; text hand; a large hand in writing, so called because it was the practice to write the text of a book in a large hand and the notes in a smaller one.

Text-book.—A volume on which a teacher lectures or comments; hence, any manual of instruction; a school-book.

Texture.—1. The act or art of weaving.

2. That which is woven; a woven fabric; a web.

3. The disposition or connection of threads, filaments or slender bodies interwoven.

4. The disposition of the several parts of any body in connection with each other, or the manner in which the constituent parts are united; as, the texture of earthy substances or minerals.

Thallium.—A rare, bluish-white metal, widely distributed, but found in small quantities; as, in certain kinds of iron and copper pyrites, in some minerals and in many mineral springs. It has a specific gravity of 11.9, and melts at 561° F. It resembles lead, and is so soft that it can be scratched with the finger nail. Thallium has been used in glass manufacture, producing a glass of extraordinary brilliancy and high refractive power.

T-handle.—A spanner or key for a cock or valve which is shaped like the letter T.

Thatching.—Roof covering of straw, reeds, or rushes. The reeds are cut in the winter, made into sheaves, dried, and stacked. With care, a roof of thatch will last one hundred years in good preservation. The reeds are laid in successive courses, eight or nine inches in thickness, the butts toward the eaves, and are held down to the roof spars by sways or rods, which are tied to the roof spars by rope yarns passed through the reeds by a needle. The total thickness at the eaves is eighteen or twenty inches. The butts of each succeeding course overlap on the course below. The *legget*, a square piece of wood with an oblique handle, is used for driving up the butts of the reeds and making them lie compactly. The ridge of the roof, where the small ends of the reeds meet, is capped with straw.

Thawing Off.—In ice making, the act of dipping the cans of freshly made ice

into warm water, so as to thaw off the ice block from the sides of the mould, the blocks being subsequently tipped out at the dump.

The.—A word placed before nouns, or the names of things, to limit or individualize their meaning.

T-head.—In carpentry, a cap over two combined openings.

T-headed Bolt.—In machinist's work, a bolt whose head is formed of a transverse piece, so that with its body, it makes the outline of the letter T. The piece which forms the upper bar fits into a recessed or undercut slot, whose overhanging edges furnish the necessary resistance to the force requisite for tightening up. This form of bolt is used where adjustability is necessary, the bolt sliding into any position within the range of the T slots.

Their.—The possessive case of the personal pronoun *they*; as, *their* tools or *their* shop.

Thence.—From that time; thenceforth; thereafter.

Theodolite.—The principal surveying instrument, used for measuring horizontal and vertical angles. It possesses a large telescope with various adjustments and frequently telemeter attachments, together with horizontal and vertical graduated circles, whose vernier adjustments may be read by microscopical eye pieces. Spirit levels and a compass are attached to the instrument for setting it, or noting its bearing.

Theorem.—In mathematics, a statement of a principle to be proved; a proposition which is demonstrably true, although it is not self evident.

Theoretical Efficiency.—In mechanics, the quality of producing an effect, or power or agency, terminating in theory or speculation; the theoretical ratio of useful work produced, to the energy expended in producing it.

Theoretical Mechanics.—The science dealing with forces and their effects upon matter; differing from *applied mechanics*, in that the latter science deals with actual examples of mechanisms and structures.

Theory.—1. The science distinguished from the art; as, the theory and practice of engineering.

2. The underlying principles of science, as distinguished from actual operation; as, the *theory* of machine construction.

There.—In or at that place; used in distinction from *here*; there usually signifies a place further off.

Thermal Resistance.—The resistance opposed to the passage of *heat* by any substance. Its amount depends upon the substance in question, the nature of its exposed surfaces, etc.

Thermal Unit.—A measure of mechanical work, found by experiment to be equal to the energy necessary to raise one pound of water 1° Fahr., in temperature. Known as the British thermal unit, or B. T. U.

Thermantidote.—An endless window screen or blind, made of cuscus grass, and mounted on a roller, its lower extremity dipping into water. It is occasionally turned a little by means of the roller, to keep the grass wet. The air is cooled by evaporation in passing over the moist surfaces of the contrivance.

Thermit.—A granular mixture of aluminum and iron oxide, in exact chemical proportions, so that a perfect union may ensue on combustion, and nothing but alumina and pure iron remain behind as products.

Thermit Welding.—A chemical process whereby internal local heat may be obtained, to fuse together iron and steel parts of considerable size. The temperature of ignition is a little less than that of molten steel, and below this it will not ignite. It is perfectly safe, therefore, against a red hot poker, or even molten cast iron; and may be thrown into an ordinary fire without injury. It would be ignited, however, by molten steel, or, indeed, by any other method which would produce the temperature of ignition, however small the area of attack. In practice, a special ignition powder is provided, which may be started by a lucifer match, thus causing a local heat of sufficient intensity to ignite the thermit, whose ingredients now combine and cause the enormous temperature of 5400° F. by their combustion. The iron being freed, the aluminum goes to form, with the oxygen, a slag of alumina, which appears as thin, dark red flakes of what may be called emery, ruby, or sapphire; both slag and iron remaining fluid at the high temperature. It is this immense evolution of heat that serves for the welding of two pieces of iron or steel, being thus analogous to electric welding, or to any other process where a sudden supply of intense heat is desired.

Thermodynamics.—The branch of the theory of heat, that treats of the relations between heat and mechanical work, especially as acting in a heat engine; as, the steam engine. This term is made from two Greek words, which signify, respectively, *heat* and *power*.

Thermodynamic Valve.—A valve depending for its operation upon the expansion and contraction occasioned by changes of temperature.

Thermometer.—A heat measurer. The term is generally applied to a glass tube, terminating in a bulb, which is charged with a liquid, usually mercury or colored alcohol. The liquid contracts or expands with changes of temperature, falling or rising in the tube against which is placed a graduated scale.

Thermometric Scale.—The graduated scale to which thermometers are referred. The common scale is Fahrenheit's, in which zero is the temperature of a mixture of salt and snow; 32° that of melting ice, and 212° that of boiling water. The Celsius and Réaumur scales run from the temperature of melting ice to that of boiling water, the former having 100 graduations and the latter 80, hence, the Celsius is called the Centigrade thermometer.

Thermoscope.—In physics, an instrument for indicating changes of temperature without indicating the degree of heat by which it is effected; especially, an instrument contrived by Count Rumford.

Thermostat.—A self acting apparatus for regulating temperature by the unequal expansion of different metals, liquids, or gases by heat; as, in opening or closing the fuel supply valve on a steam automobile, or the like, as the heat becomes less or greater than is desired.

Thermosyphon.—In an automobile, an application of the principles of convection to the circulation of cooling water around the cylinders. The heated water rises from the jackets and syphons over into the radiator, whence it travels back to the supply tank. This combination of syphon action and convection obviates the use of a circulating pump.

Thick.—1. Having more depth or extent from one surface to its opposite than usual; not thin or slender; as, a thick plank; thick paper; said of a solid body; as, a timber 7 inches *thick*.

2. To a great depth or to a greater depth than usual; as, a *thick* soil over the rock.

Thickening Machine.—In wood working, a machine used for the purpose of planing stuff to a gauged or parallel thickness, two *adze* blocks being used, one of which is movable for adjustment to the required thickness.

Thick Stuff.—A term denoting any semi-liquid, more especially a magma or fluid in sugar making.

Thief Tube.—A tube for withdrawing samples of liquids from casks, etc.; a *sampling tube*. Some *burettes*, *pipettes*, and *dropping tubes* are made on the same principle.

Thill.—1. In mining, the surface or rail on which a tram runs; also the floor of the mine.

2. A shaft; one of the two side pieces by which one horse is hitched to a vehicle.

Thimble.—1. A ring of metal around which a rope is spliced to form an eye.

2. A tube or sleeve, surrounding a bolt, serving as a distance piece between the two parts united by the bolt; as, in a locomotive boiler.

Thimble Joint.—A sleeve coupling forming a double bell into which the male ends of two cast iron pipes are inserted and caulked with spun yarn and lead. A double female coupling or *double bell*, as in cast iron water pipes.

Thing.—1. Whatever exists, or is conceived to exist; as, a separate entity.

2. An inanimate object, in distinction from a living being; any lifeless material.

3. A transaction or occurrence; an event; a deed.

Thinning of Boiler Plates.—When the tube sheet and tube ends near the sheet become coated with scale or the tubes become overheated, the metal wastes away, thus resulting in thinning. This can usually be detected by examination, sounding with a round-nosed hammer, or drilling small holes in suspected parts not otherwise accessible for examination.

Third.—1. Next after the second; coming after two others.

2. The quotient of a unit divided by three; one of three equal parts into which anything is divided.

Third Rail.—A bar conductor of electricity, properly insulated, running parallel with the railway track, and at the same level as the rails, transmitting power from a central point to the motors of the train.

Third Speed.—In an automobile transmission, a speed next higher than second speed.

Thirl or Thurl.—In mining, to drill or bore for shot firing; also a mark in a lead mine, denoting the boundaries of a set or pitch.

Thirling.—The meeting of tunnel workers who have been approaching each other from opposite ends.

Thirteen.—One more than twelve; ten and three.

Thole.—1. In navigation, a pin inserted in the gunwale of a boat to serve as a fulcrum for the oar in rowing. They are arranged in pairs, the space between forming one kind of *rowlock*.

2. In architecture, the scutcheon or knot at the center of a timber vault.

Thong.—1. A strap of leather.

2. A tool used by blacksmiths, etc., for handling iron or any other metal which is too hot to be touched with the hands.

Thorium.—A rare white metal, specific gravity 11, which has not been melted. Its compounds, as in the ordinary Welsbach mantle, are radio-active, though doubt exists as to the radio-activity of thorium itself.

Thornycroft, Sir John Isaac.—Born 1843. An English naval architect and engineer. At the age of seventeen, he built from his own designs, a steam launch with original engines which anticipated many principles essential to the construction of the swift boats with which his name became afterwards identified. In 1866, he founded shipbuilding works at Chiswick, for the building of launches. The speed attained by his boats brought him wide reputation which was greatly increased by his later success in the development of torpedo boats. The invention of the Thornycroft water tube boiler followed.

Thoroughfare.—A passage through; a passage from one street or opening to another; an unobstructed way open to the public; a public road; hence, a frequented street.

Thoroughfare Taps.—In machinist's work, taps whose square heads are sufficiently small to allow them to pass through the hole which has been tapped with them, and so save the time which would otherwise be lost in running them back.

Thousand.—Ten times one hundred; a collection or sum consisting of ten times one hundred units or objects.

Thread.—1. The spiral projecting rib on the shaft of a screw.

2. Something continued in a long course or tenor; as, the thread of life, or of a discourse.

3. A filament; as, of a flower, or of any fibrous substance; as, of a bark; also a line of gold or silver.

4. A very small twist of flax, wool, cotton, silk, or other fibrous substance, drawn out to considerable length; a compound cord consisting of two or more single yarns doubled, or joined together and twisted.

5. A slight vein of ore, smaller than a branch, passing off from the main vein into the rock.

Threadbare.—Worn to the naked thread; having the nap worn off; as, threadbare linen.

Thread Gauge.—A gauge for determining the number of threads to an inch on screws and taps. It consists of a number of toothed plates turning on a common pivot, so that the saw-like or serrated edge of each may be applied to the screw until one is found which corresponds therewith. The figures stamped on the plate indicate the number of threads to the inch.

Threading Tool.—A pointed lathe tool for cutting screw threads ground to an angle, corresponding to that of the thread. Also termed *screw cutting tool*.

Threat.—The expression of an intention to inflict evil or injury on another; the declaration of an evil, loss, or pain to come.

Three Cylinder Engines.—In steam engineering, these may be divided into two main classes, those in which the cylinders are placed at an angle of 120° to each other, and those in which they are ranged side by side. The pistons of three cylinder engines being in equilibrium, there is no balancing of reciprocating parts required, and they can be run at a much higher speed and steadier than engines of the ordinary reciprocating type. Hence, they are employed for driving dynamos, centrifugal pumps, circulating pumps, and high speed machinery, generally. The foregoing relates to engines having three high pressure cylinders of equal size, and does not apply to a three cylinder triple expansion engine with respect to the balancing features.

Three Cylinder Pump.—One having one inlet and outlet common to the three cylinders; this produces a more nearly uniform discharge, by the diverse position of the three-throw crank to which the pistons are attached. Used in pumping air to a submarine diver, etc.

Three High.—In a rolling mill, a machine consisting of three similar superposed pieces. A roll train is said to be three high when there are three rolls in a tier in each trossing, the pieces to be rolled being

passed first through the lower pair and returned between the upper pair. This obviates the necessity for reversing the rolls or passing the billets back over the top, as would be the case with a two high train.

Three Jaw Chuck.—A self-centering chuck with three jaws or dogs, used for light lathe work or on pipe threading machinery. It is not suitable for heavy work nor is it easy to set work accurately in it, but for certain purposes its rapidity of adjustment is a compensation.

Three Lift.—Said of a gas holder or gasometer, when it is formed in three concentric cylindrical sections working within each other, like the draws of a telescope.

Three Ply.—Consisting of three distinct webs inwrought together in weaving; as, cloth or carpet; having three strands; threefold.

Three Square File.—A triangular file, having teeth on either face. A *saw file*.

Three Throw Crank.—A shaft having three cranks forged upon it at angles of 120° for driving three valves, or buckets or pistons, and used chiefly for pumps. The cranks being so arranged, are in equilibrium in any position, and can be run smoothly at a high rate of speed and also started in any position. This sequence of cranks is generally used with triple expansion engines, producing an almost uniform torque; the order of turning being, high pressure crank leading, and intermediate and low pressure cranks, respectively, following.

Threeway Cock.—A cock having three branches or passages for the delivery of the fluid passing through it.

Threeway Valve.—In pipe and steam fitting, a valve having three delivery branches, either sockets or flanges, for diverting the liquid from the inlet branch into different directions at pleasure.

Thresher.—1. A short term applied to the threshing machine.

2. One who, or that which, threshes grain.

Thresherman.—A person who hires out or operates a threshing outfit for grain; this usually consists of a self-propelling engine, which hauls the rest of the machinery from place to place, a thresher or separator, and an elevator or straw stacker.

Threshing Machine.—A combination machine, whereby grain of wheat or other cereals is separated from straw and chaff. The grain is fed to a rotary cylinder or drum, provided with beater bars, which rub out the grain from the ears against a concave screen of alternate bars and wire work, the straw is taken away for stacking by means of a conveyor or "elevator," and the grain further subjected to the process of *winnowing* in the same machine by means of shaking riddles or screens, and the action of a fan blast, which rids it of dust and chaff, finally delivering the clean wheat, etc., into sacks.

Threshold.—The plank, stone or piece of timber which lies under a door, especially of a dwelling house; the door sill; hence, entrance; gate; door.

Throat.—1. A contracted portion of a vessel, or of a passageway; as, the throat of a pitcher or vase.

2. In architecture, the part of a chimney which contracts in ascending, and the flue.

3. In navigation, the upper fore corner of a boom and gaff sail, or of a stay sail; that end of a gaff which is next the mast; the angle where the arm of an anchor is joined to the shank.

4. In shipbuilding, the inside of a timber knee.

Throat Plate.—In railway engineering, the plate dividing the fire box from the cylindrical portion of the shell of a locomotive boiler.

Throat Sheet.—In a locomotive, the flanged plate at the forward end of the fire box, which makes connection between the rectangular and the cylindrical portions of a boiler. Also called *throat plate*.

Throe.—A tool for splitting balks of timber into shingles or clapboards. A *trow*.

Threstle.—In manufacturing, the drawing frame of cotton manufacture, succeeding the spinning jenny.

Throttle.—1. In steam engineering, to choke, hence to reduce the speed of or stop an engine by closing the steam supply valve.

2. The regulator in a locomotive; a butterfly or double beat valve, used to check the speed of marine or stationary engines, worked by hand or in connection with a governor.

3. A machine for spinning wool, cotton, etc., from the rove, consisting of a set of drawing rollers with bobbins and flyers, and differing from the mule in having the twisting apparatus stationary.

Throttle Box.—In a locomotive, a chamber or valve body, fixed on the upper end of the dry pipe within the steam dome,

in which the throttle valve works, steam passing directly into it from the boiler as soon as the valve is opened.

Throttle Damper.—A regulator for the draught in a chimney or flue, shaped like a butterfly valve or throttle.

Throttle Lever.—The handle or lever in the cab by means of which the engine-man actuates the throttle valve.

Throttle Pipe.—A cast iron standard, forming the upward bend of the dry pipe into the steam dome, on a locomotive, the throttle box or throttle valve body being attached to its upper extremity. Also known as *throttle stand-pipe*.

Throttle Rod.—The rod or bar by means of which the pull of the valve lever is transmitted to a bellcrank within the dome, which in turn moves the valve stem and the throttle.

Throttle Stuffing Box.—A stuffing box on the back head of a locomotive fire-box, keeping tight the opening through which the throttle rod passes into the boiler.

Throttle Valve.—In steam engineering, a valve which regulates the supply of steam to the cylinder.

Throttle Valve Stem.—In steam engineering, a bar or stem which by a screw operates the ordinary conical valve; also called *throttle valve*.

Throttling.—The throttling of steam in the passage of an engine cylinder, which takes place when the passage is so contracted that the rate of travel of the entering steam falls behind that acquired by the piston towards the termination of its stroke.

Throttling Engine.—A steam engine controlled by a governor which operates the throttle valve, as distinguished from the more elaborate types which are controlled by automatic expansion.

Throttling Governor.—A controlling mechanism applied to a steam or gas engine, which operates by varying the rate of supply of working fluid supplied to the machine. In steam engines, a valve contracts the supply passage according to the demand; with gas engines, similar valves vary either the amount of gas admitted or the quantity of mixture supplied; the first being known as *qualitative*, the second as *quantitative* governing.

Through.—1. From end to end of, or from side to side of; as, to bore *through* a piece of timber.

2. From beginning to end; as, to read a letter *through*.

Through Bolt.—In machinery, a bolt passing entirely through, and fastened on opposite sides of the object or objects secured by it.

Through Braces.—Longitudinal steam space stays within a boiler; also termed *head to head stays* and *through bolts*.

Through Bridge.—One in which the track rests on the lower stringer, in contradistinction to a *deck* bridge, in which the track occupies the upper stringer, the top of the truss.

Throughout.—In every part; as, the quality of the iron was equally good *throughout*.

Through Stone.—A bond stone extending across the thickness of the wall. A *perbend*.

Throw.—1. To fling or cast in a winding direction; to whirl; to hurl.

2. To wind or twist two or more filaments of, as silk, so as to form one thread; to twist together, as *singles*, in a direction contrary to that of the singles themselves; sometimes applied to the whole class of operations by which silk is prepared for the weaver.

3. To form or shape roughly on a throwing engine or potter's wheel, as earthen vessels.

4. In mechanics, the extreme movement given to a sliding or vibrating reciprocating piece, by a cam, crank, eccentric, or the like; travel; stroke; as, the *throw* of a slide valve.

5. In mining, the same as *heave* or trouble.

Throwing Wheel.—The potter's wheel; a revolving horizontal table upon which the potter shapes plastic clay into articles of a circular form. The material is manipulated by hand, being built up as required, the desired outlines being imparted by means of the fingers, assisted by horn or bone tools and templates or sweeps. Gauges, projecting horizontally from a post beside the wheel, assist the potter to make the various parts of the correct height. Also called *throwing engine*.

Throw Lathe.—A small lathe which is driven by one hand, while the tool is managed by the other.

Thrown Silk.—A silk consisting of two or more *singles* twisted together, like a rope, in a direction contrary to that in which the singles, of which it is composed, are twisted.

Thrum.—1. One of the ends of weavers' threads; a tuft.

2. Coarse untwisted rope, used for mops and for mat making.

Thrust.—In coal mining, a crushing of the pillars by the weight of the roof, the floor being harder; opposed to *creep* which is an upheaval of the gallery floor.

Thrust Bearing.—1. In a screw steamship, a bearing affording means to receive the endwise thrust of the propeller. It usually consists of a series of collars upon a separate length of shaft, the collars abutting on the surfaces of a number of horseshoe shaped pieces, which are secured into a heavy casting that is rigidly connected with the vessel's framing. The pressure on the thrust bearing is the reaction due to the forward impulse given to the ship.

2. A bearing provided to receive the endwise thrust of a shaft by means of collars, etc.

Thrust Collar.—One of a number of rings formed on a thrust shaft, by means of which the endwise thrust of a propeller, etc., is communicated to the horseshoe or other bearing pieces.

Thrust Shaft.—A separate length of shafting on which are formed the collars for the thrust bearing of a marine engine. It is usual to forge the shaft from a heavy ingot, and turn the collars out of the solid.

Thumb Nut.—A nut fitted with projecting wings, so that it may be loosened or tightened by hand.

Thumb Screw.—A screw furnished with a large winged head, in line with its axis, so that it may be manipulated with thumb and finger.

Thumb Tack.—A drawing pin or flat-headed tack used to secure paper to a drawing board.

Thwart.—One of the transverse planks which keep the sides of a boat apart, like the beams of a ship, and serve as seats for the rowers. They are spaced about 2 feet 10 inches apart from center to center, in single banked boats, and 3 feet in double banked boats.

Tick.—A woven fabric for holding the filling of mattresses, etc., also called *ticking*; *ticken*.

Ticket.—A piece of card, paper, metal, or what not, printed or plain, the equivalent of a sum of money paid for a ride, admission to a game, etc.

Tickler.—1. A book or case containing memoranda; a reminder of things to be done at a future time; a record of matters to be kept in mind for a short period.

2. In a carbureter, a pin arranged so as to depress the float in priming. Also called *primer* and *flushing pin*.

Tidal Alarm.—An audible alarm operated by the ebb and flow of the tide. It is placed on a spit or shoal, to warn off vessels during fogs; being on a vessel or buoy, moored to the spot, or on a post or pile driven into the sand or shingle. It may be a bell, whistle, or trumpet, rung or blown by the impact of the passing tidal current. Also called a fog alarm.

Tide.—The alternate rising and falling of the waters of the ocean and of the bays, rivers, etc., connected therewith. The tide *ebbs* and *flows* twice in each lunar day, or the space of a little more than twenty-four hours. The flow or rising of the water is called *flood tide*, and the reflux, *ebb tide*.

Tide Gauge.—A device used in harbors to measure the rise and fall of the tides. Also called *tide dial* and *tide meter*.

Tide Mill.—A mill driven by a wheel set in motion by the tide. Mills of this kind were in use in Venice as early as 1078, and they were employed in London in 1772. Generally the water is admitted as the tide rises, through a sluice over which the mill is placed, into a reservoir, turning the wheel in its passage through the sluice. At high tide the sluice gates are shut until the tide has fallen sufficiently, when they are opened, and the water again turns the wheel, during its outward passage.

Tide Power.—In hydraulics, the power which is exerted by the rising and the falling of the tide. Attempts have been made to impound arms of the sea, and utilize the inflow and ebb of the tide by means of water wheels in the passage-way, but the extreme variations in power have rendered the efforts unsatisfactory.

Tie.—1. In building, a beam or rod which secures parts together and is subject to a tensile strain; as, a *tie beam* which is opposite of a *strut* or straining piece.

2. In railways, a piece of timber laid across the track and held down by *ballasting*, serving to retain in place the rails which are spiked to it; a *sleeper*.

Tie Beam.—A horizontal member of a truss or a frame connecting posts. In a

roof truss, the king or queen posts and principal rafters are stepped into it, and it takes the outward thrust of the rafters.

Tier.—1. A row or rank in which similar things may be placed in order; the term is usually applied when two or more rows are arranged above one another, as *tiers* of seats, etc.

2. A row in which ships may be moored alongside each other, or in line in a stream, or alongside a wharf.

3. A place below decks where the cable is coiled in a ship; the *cable tier*.

Tierce.—1. A word akin to the Latin, *tertius*, a third; hence, a third or third part.

2. A cask whose content is a third of a pipe, equal to forty-two gallons; it constitutes also a third measure between a barrel and a hogshead.

Tie Rod.—1. A long screwed bolt or stay passing from one wall of a building to another; the nuts on the tie rod hold plates or bars up against the masonry, thus affording mutual support between the parts it binds together.

2. One of the rods which support the jib or lifting arm of a crane; also termed *tension rod*.

Tight.—In mechanics, close, firm, closely fitting; firmly secured without looseness or possibility of relative motion; difficult of entry or gripping firmly when entered.

Tightening Pulley.—One which rests against the belt in order to tighten it, to increase its frictional adhesion to the pulleys over which it runs.

Tight Fit.—In machine work, a term applied to work which is made to an exact fit, so that no play whatever is allowed; as, the keys in shafts are generally *tight fits*.

Tight Pulley.—That one of a pair of fast and loose pulleys which is keyed to the shaft, while its mate is free to revolve. The belt runs idly on the loose pulley, and being shifted sidewise to the tight one, sets the shaft in motion.

Tile.—1. A plate or thin piece of baked clay, used for covering the roofs of buildings, for floors, drains, etc.

2. A small, flat piece of dried earth or earthenware, used to cover vessels in which metals are fused.

Tile Drain.—In construction work, a drain made of baked earthenware or tiles, which are formed in different sizes, colors and qualities.

Tile Float.—A float made out of a large tile, used for automatic valves in hot liquids under pressure, as for low water alarms, automatic feed arrangements, water softeners, etc. Hollow metallic floats are liable to corrode and leak, rendering them useless, while the tile is solid. The tile weighs twice as much as water, but rather more than half its weight is balanced by an iron weight affixed to the opposite arm of the lever to which the float is attached, thus keeping the tile always on the surface of the liquid.

Tiller.—1. A lever attached to the rudder head of a small craft whereby the rudder is manœuvred; the helm of a vessel.

2. An arm, lever, quadrant, or sector serving as helm in large vessels, through which a steam, hydraulic, or electric steering gear operates upon the rudder.

3. A lever pivoted at the center of the foot-board or dashboard of a small motor vehicle, which actuates the steering links connected with the front axle, and thereby directs the course of the car.

Tilt.—1. A cover of canvas or tarpaulin stretched over hoops or bows, such as is used to protect the contents of wagons, passengers in steam launches, etc.

2. A tilt hammer.

Tilt Hammer.—The word *tilt* is derived from a root which means a lifting or up and down motion, which is descriptive of the action of the tilt hammer. The hammer stock is acted upon by a *wiper wheel* whose cogs or cams first tilt the hammer and then allow it to drop upon the object on the anvil.

Tilting Furnace.—An open hearth steel furnace which is mounted upon trunnions so that it may be tilted for pouring the molten metal into the ladles.

Tilt Mill.—In a furnace, a building where a tilt hammer is used.

Timber.—A single piece or squared stick of wood for building, or already framed; the larger pieces or sticks of wood, forming the framework of a house, ship or other structure, in distinction from the covering or *boarding*; the material for any structure; lumber dressed for use.

Timbering.—The supporting of the sides and roof of an excavation by means of stout timbers; as, in mining or tunneling work.

Timber Measurement.—Timber is measured in various ways. By the *superficial foot*, reckoned as one inch thick, as in boards; by the *cubic foot*, as in logs or beams; by the *load*, as in wholesale dealing; by the *hundred*, as in deals and batens.

Timber Pond.—An enclosed portion of water, wherein logs of timber float, for storage and protection.

Timber Preservative.—A solution injected into the pores of wood to prevent rot and preserve it from the attacks of insects. In the "Ferrell" process, sulphate and chloride of aluminum are employed; various metallic salts, such as bichloride of mercury, sulphate of copper and zinc chloride have been also tried. The best of all preservatives is *creosote*. Seasoned timber is placed in a long, closed, wrought iron cylinder, from which the air is exhausted; creosote at 120° F. is then pumped in until a pressure of 170 lbs. per sq. inch is attained. Soft wood will absorb a maximum of 12 lbs. creosote per cubic foot, very hard woods not more than 3 lbs. Timber must always be well seasoned before painting, as the coat of paint tends to imprison moisture, rendering the wood liable to rot.

Timber Rack.—A storage for timber, made generally on the sides of the shop and well overhead. It consists of brackets and is able to hold a large quantity of lumber without disturbing the space or accommodations on the shop floor.

Time.—1. Duration considered independently of any system of measure; endless succession.

2. To regulate as to time; to arrange the various parts of a machine so that they shall perform their several parts at the precise or appointed moment.

Time Ball.—A ball which is hoisted to the top of a conspicuous pole, and dropped by electric current from some observatory, at a predetermined time; as, at twelve, noon, to serve as an indication of the correct time.

Time Fuse.—1. A fuse, fitted to a shell, which can be adjusted to an index when loading, by cutting off the fuse ribbon, composition-filled tube, or the like, thus prearranging the time when the explosion shall take place.

2. A rope-like combustible, so constructed that its rate of burning can be accurately foretold, thus permitting a definite time to elapse between lighting the fuse and the explosion of a blast or mine.

Timekeeper.—One who keeps a record of the time worked by employes, and

notes their times of arrival and departure, either in a mercantile house, or in a manufactory.

Time Lock.—A lock whose mechanism is so arranged that, when locked, it may not be opened, either before the expiration of a given time, or, more generally, before a certain hour, to which it has been previously set.

Timer.—A device forming a part of the jump spark ignition system of internal combustion engines. It consists of a revolving switch operated by the engine, and has a contact point for each cylinder which the switch in revolving touches, and completes the primary circuit at such times as the secondary current is required for the production of the spark. Also called *commutator*.

Time Sheets.—In workshops, printed slips of paper with headings for dates on which workmen write out each day's time; that is, the number of hours which they have worked and the jobs upon which they have been engaged. These are collected and sent into the office and checked against the time as given in by the gate keeper.

Time Signal.—1. A telegraphic signal given from an observatory to distant points, electrically connected therewith, to indicate standard time at noon or some other convenient hour, thus ensuring correct and uniform time at all points.

2. A signal given by time ball, cannon, etc., to indicate a certain known hour, generally noon, 1 P. M., or 9 P. M., thus giving a standard time.

Time Table.—1. A table giving the times of starting and arrival, at each station, of the daily trains on a given road.

2. A record of time of employees.

Timing.—1. In mechanics, the regulation of the parts of a machine so that all the motions shall take place in due time and place.

2. The system or process by means of which the moment of ignition is regulated, in an internal combustion motor.

3. The arrangement of the ignition period, more especially in a multi-cylinder engine; an analogous expression to *valve setting* in regard to a steam engine.

Timing Lever.—A lever fitted to motor vehicles by means of which the time of ignition is advanced or retarded, or, as it is frequently termed, the *spark lever*, because it controls the timing of the electric spark.

Timing Valve.—A valve controlling the passage between the combustion space and the igniter of internal combustion engines using hot tube ignition. The valve is opened, usually by a cam on the half speed shaft, at the time the piston reaches the end of its compression stroke, thus effecting communication between the charge and the igniter.

Tin.—1. In mechanics, thin plates of iron covered with tin.

2. In chemistry, one of the few *elementary substances* of which the world is composed. It is found as an oxide, and reduced into a malleable, fusible, soft, white, lustrous metal, and used for numerous purposes.

Tin has a specific gravity of 7.29, melts at 450° Fahr.; is very malleable, being capable of being beaten and rolled into *tin foil*, but becomes brittle at 390° F. It forms part of many important alloys; with copper to form *bronze* or *gun metal*; with antimony to constitute *Britannia metal*; with varying proportions of lead, to make *pewter* and *solder*; sheet iron or steel is coated with it to form *tin plate*. Cast refined tin in ingots is known as *block tin*; when heated to the temperature at which it becomes brittle, it constitutes *grain tin*.

Tinder.—Any highly inflammable substance that may be ignited by a spark. Before the introduction of matches, charred linen or touchwood was kept in a metal *tinder box*, or in a stoppered horn, and the tinder ignited by sparks from flint and steel, to obtain fire or a light.

Time.—A projecting point, the spiked or penetrating portion of any instrument; as, the tines of a harrow, a pitchfork, or the antlers of a stag.

Tin Foil.—Very thin sheet tin; often alloyed.

Tin Glass.—The glass maker's name for *bismuth*.

Tin Glaze.—An opaque glaze or enamel having oxide of tin as a basis, used upon fine pottery; as, upon majolica ware.

Tinker.—1. One skilled in a variety of small mechanical work.

2. To mend or solder; as, kettles and other metal ware.

Tinker's Dam.—A wall of dough raised around a place which a plumber desires to flood with a coat of solder; as the material can be used but once, being subsequently thrown away, it has passed into a proverb.

Tin Lined Pipe.—Lead pipe lined with tin in order to prevent the formation of injurious salts by the action of water on the lead. The process of coating the inner surface of lead pipe with tin was first introduced by Anderson in A. D. 1804.

Tin Liquor.—In dyeing, a solution of tin, digested in hydrochloric and nitric acids, with an addition of salt.

Tinman's Shears.—Hand shears four to nine inches in length; the ends of the handles are bent towards each other so as to meet when closed; also known as *snips*. The *bench shears* are eighteen or more inches in length and one handle is bent down, forming a square tang, which is inserted through a hole in the bench; the other handle operates the movable blade of the shears.

Tinman's Solder.—Ordinary or fine tin solder is composed of two parts of tin, one of lead, and melts at about 360° Fahr. *Plumber's solder*, such as is used in tinning, consists of one part tin, three parts lead, melting at about 500° Fahr.

Tinned Nails.—In a foundry, moulders' nails coated with tin to prevent rusting and the consequent formation of blow holes.

Tinners' Folding Machine.—One in which the sheet metal, cut to the required shape or size, is laid upon the bed piece, held by a lever, and bent up against the *former* by a folder. The sides of the sheet, as made into a pan, are operated upon consecutively.

Tinning.—1. The act, art, or process of covering or lining anything with melted tin, or with tin foil.

2. The covering or lining of tin thus put on.

Tin Plate.—A thin sheet of rolled wrought iron or mild steel covered with a protective coating of tin by dipping in the molten metal, thus forming an alloy with it. After preliminary *scaling*, by dilute hydrochloric acid, heating, hammering, and rolling, the plates are *pickled*, first in acidulated bran, then in a solution of sulphuric acid. This is followed by a clean water bath and scouring with sand and hemp. A number of plates previously greased, are plunged for an hour or more in a bath of molten tin, whose surface is protected against oxidation by a thick layer of tallow. Upon removal, after draining in an iron rack, the sheets are placed in a second bath from which they are taken out singly, swept with a hemp brush, and dipped a third time to remove the brush marks. Next, they are dipped into melted tallow, and allowed to drain once more. Following this, the plates are

dipped into a pot containing a little tin, which melts off the *list* or rim of tin along either end; the grease is removed by rubbing with dry bran; the plates are finally sorted and boxed for world-wide consumption.

Tin Saw.—In bricklaying, a saw used for cutting kerfs in bricks in order to render them more readily dressed by the axe which hews them into shape for the skew or gauged work, dome, or niche for which they are destined.

Tin Scrap.—Clippings or scraps made in the manufacture of tinware, in which it is said six per cent of the tin plate used disappears in the form of scrap.

Tinsel.—A shining material used for ornamental purposes, and consisting either of cloth, or of very thin metal overlaid with a thin coating of gold or silver, brass leaf or foil, and the like.

Tinsmith.—One who makes articles out of tin plate, the parts being united either by soldering or by crimping the meeting edges into a seam, which may be soldered afterwards, if required.

Tinstone.—The ore of tin, occurring in the condition of an oxide. It is found in Cornwall, Malacca, Banca, Australia, Bohemia and Saxony. That from Malacca and Banca is known as *Straits tin* or *Banca tin*.

Tin Tack.—A tack dipped in melted tin and thus rendered *rustproof*.

Tints.—Delicately shaded hues, not so pronounced as colors. The light colorings used by draughtsmen to indicate various materials are properly denominated *tints*.

Tip.—1. To cause to lean to one side; to tilt anything so that it discharges its contents.

2. To discharge earth, rock or other matters from tilting wagons, so as to form an embankment or mound.

3. Possessing a device permitting tilting to empty; as a *tip wagon*.

4. A runway fitted with appliances to discharge railway wagons by tipping, used more especially for coal or ore.

5. A place whereon materials are deposited by tipping; usually refuse matters, such as, ironworks slag, the valueless tailings of crushed ore, etc.

Tip Mound.—A tip or dump for slag or mine refuse; a mound caused by tipping waste material.

Tipping Bucket.—In construction work, a bucket made of iron or wood and in

different shapes, to hoist and tip wherever desired, concrete, coal, stone, ballast, etc. They swivel on trunnions and throw the contents out at the top of the bucket, or dump their contents by opening the bottom by certain mechanical devices.

Tipple.—1. In coal mining, the heap on which the coal is discharged from the tubs or cars, at the pitmouth.

2. To put up in bundles in order to dry; as, hay.

Tip Wagon.—A small fourwheeled railway vehicle used in construction work for forming embankments, etc. It usually tilts at one end only, although, others are made to tip from either side.

Tire.—1. A band or hoop of iron or rubber, used to bind the felloes of wheels to secure them from wearing and breaking; as a wagon tire.

2. In a locomotive, a heavy hoop or band of iron or steel, on the circumference of the driving wheels, to impart strength and prevent wear.

Tire Band.—In an automobile, a band of rubber, insertion or other fabric to protect or repair a damaged pneumatic tire.

Tire Bender.—A machine provided with adjustable cylindrical rolls, for bending iron bars into a circular form for hoops or for tires of vehicles.

Tire Bolt.—In wheelwrighting, a bolt whose head is countersunk, in which the taper of the countersunk part is on an acute angle, and which is used for fastening the tire to wheel bodies. The nut is fastened within the rim.

Tire Brake.—A cycle or automobile brake which presses upon the surface of the tires, usually by means of rollers or a spoon shaped shoe.

Tire Fastening.—The act or means of securing a tire to a wheel; with railway vehicles it is necessary to arrange, first, that the pressure of the brakes shall not cause the tire to revolve around the wheel center; secondly, that in case of fracture, the portions of the tire shall not fly apart.

Tire Pump.—A portable plunger air pump used for inflating pneumatic tires of cycles or automobiles.

Tire Ring.—In car wheels, rings of wrought iron employed for uniting the tires to those railway wheels which have wooden bodies. They are annular rings, each having an internal flange on its periphery, which fits into corresponding grooves, one on each side of the ring. The rings being bolted together through the wooden body, clasp the tires securely in the grooves.

Tire Rivet.—A form of rivet, specially used for fastening tires to wheel bodies. The end which enters through the tire is conical, the part passing through the body parallel, and the riveted end is formed within the rim. It is, therefore, a countersunk rivet in which the taper of the countersunk part is small.

Tire Shrinking.—The operation of placing tires upon the wheels of vehicles. The tire is bored or made slightly less in diameter than the felloe or rim, and is expanded by heat to make it large enough to be pressed or driven on, the subsequent cooling making it tightly press its wheel.

Tire Sleeve.—A sleeve for protecting the injured portion of a pneumatic tire; it covers a greater length of the circumference than a *tire band*.

T Irons.—In construction work, rolled wrought iron bars whose section is that of the letter T. They are largely employed in the construction of bridges, towers, girders, roof work and machinery frames.

Tissue Paper.—A very thin, soft paper, almost transparent, used for wrapping delicate and valuable articles; it is unweighted and has very little size; much of it is of Chinese or Japanese origin, made from native fibers.

Titan Crane.—A very large crane used for setting blocks in the construction of piers, breakwaters, etc. A cantilever traveling way projects from either end of a gantry, which spans the whole breakwater or pier; a traveling crane moves on these ways, being balanced by another traveling balance weight on the rear cantilever. No sluing motion is provided, but the Titan has three motions, the crab transversely, the traveler longitudinally on the gantry, and the gantry itself along rails on the pier; by these means a very great range of block setting can be covered.

Tit Drill.—A flat drill for boring, having a cylindrical point or tit which works within a small central hole previously drilled; this enables a very true hole to be drilled.

Title.—1. An inscription put over or upon anything; as, a name by which it is known.

2. The inscription in the beginning of a book, usually containing the subject of the work, the authors' and publishers' names, date, etc.

3. A name; an appellation; a designation.

4. In bookbinding, the panel for the name, between the bands of the back of a book.

T Joint.—A welded joint employed for uniting pieces of bar iron standing at right angles to each other. The end of the bar, which forms the vertical part of the T, is spread out, and set down or fullered crosswise, and laid upon a similar set down and fullered portion of the face or the transverse bar.

Tobacco Press.—These are of several kinds:

1. For pressing granulated tobacco into bags, pockets, or boxes, for convenience of package.

2. For pressing plug tobacco into shape; the leaves having been booked and wrapped, are pressed flat, so as to lie compactly in the box or tub.

3. For pressing plug tobacco in the box or tub, to compact the rolls, cuts, plugs or twists.

Tobacco Stripping Machine.—One for tearing or cutting out the main stems or stalks of tobacco leaves. Also called *stemming*.

Tobacco Wheel.—A machine by which leaves of tobacco are twisted into a cord. It resembles the hayband machine, or machine for twisting hempen yarns.

Tobin Bronze.—A non-corrosive bronze of great tensile strength, capable of being forged at a dark red heat; much used in marine work.

Toe.—The pointed extremity of any part which resembles a foot, in appearance or use; as:

1. The release corner of an indicator diagram.

2. The lower bearing end of a vertical shaft working in a footstep.

3. The outer bottom corner of an embankment or dam.

Toed.—In carpentry, a brace, strut, or stay is said to be *toed* when it is secured by nails driven in obliquely and attaching it to the beam, sill, or joist.

Toe Weight.—A metal knob attached to a horseshoe or a horse's hoof to induce the horse to change its motion.

Toggle.—1. In navigation, a small wooden pin tapering towards both ends with a groove around its center. It is fixed transversely in the bight of a rope, to secure any other bight of a rope to, for the convenience of applying or removing them expeditiously, or passed through a link of a chain which is itself passed through a link of the same or a different chain, in order to fasten them together.

2. In mechanics, the movable barb of a toggle iron.

3. A cross bar usually heavier at one end than at the other, attached to a chain or rope for placing inside the manhole of a tank or the like; as, for hoisting. Called also *tank toggle*.

Toggle Iron.—A harpoon for killing whales or walruses, having a movable barb pivoted in its center to the front end of the shank, and so arranged as to turn crosswise when it enters the animal's flesh and anchor itself, enabling the whalers to haul their boat closer.

Toggle Joint.—An elbow joint; a mechanism common in many forms of presses and in stone crushers; by its action it gives an enormous mechanical advantage. It consists of two rods or plates *hinged* together and employed to transmit a varying force by side pressure on the hinge, which is called the *knuckle* or knee from its resemblance to the knee of a man.

Toggle Press.—Any press applying pressure through a toggle joint; as, in a brick moulding machine, in which the power is applied through a toggle joint, the resulting compression giving a very dense brick.

Toil.—Labor, especially fatiguing work; hence, any oppressive task.

Toll Bar.—A gate or bar placed across a road to stop animals and vehicles to collect toll. Also called a *toll gate*.

Tombac.—Any one of several copper and zinc alloys; an East Indian alloy for cheap jewelry; as, copper, 16; tin, 1; zinc, 1. *Red tombac* is composed of copper, 11; zinc, 1. Arsenic is added to make *white tombac*.

Tommy.—1. In machinery, a pointed, round bar or lever used for insertion in the holes drilled in the circular back nuts of lathes and other machines for the purpose of tightening them up.

2. In machinery, a metal rod or bar kept for insertion in the eyes of the tightening screws of hand rest sockets, for tightening the T rest. Also called a *podger*.

Ton.—A measure of weight or quantity; 1. The weight of twenty hundred

weight; i. e., 2000 lbs., this being sometimes called the *short ton*, while that of 2240 lbs. is called the *long ton*. In England, the latter (2240 lbs.) is called the ton, while in the U. S., in certain transactions, as in buying coal at the mines, the *long ton* is used.

2. In navigation, a certain weight or quantity of merchandise, with reference to transportation; as, freight.

Tone.—Sound, or the character of a sound, or a sound considered as of this or that character; as, low, high, loud, grave or harsh tone.

Tongs.—1. A gripping instrument, consisting of two pieces working on a rivet as pivot, the opposing jaws being of various shapes, to hold different sections of metal; as, *flat bit tongs*, *rivet tongs*, *crucible tongs*, etc.

2. A lifting or holding implement, similar to the above, but with the hinge or flexible part near the handle, by means of which sugar or chemicals are transferred from one vessel to another, or coal is taken from the hod and placed on the fire.

Tongue.—1. The shaft or pole of a two-horse vehicle.

2. The vibrating slip of metal within a metallic frame, by means of which a musical note is made; as, in a concertina or reed organ.

3. The movable rail in a switch or points, by which the wheels of a train are directed from one line of rails to another.

4. A fin or ridge along one edge of a plank or board, fitting into a corresponding groove or furrow in the next plank.

5. The clapper of a bell.

6. The movable part of a bevel gauge, the main part constituting the stock.

7. The shorter arm of the instrument known as the *steel square*.

Tongued Heading.—A heading joint between the ends of two flooring boards, the head or end of each plank being grooved and a matching piece, tongue or spline of hard wood or metal being fitted into the recesses.

Tongue Joint.—1. In blacksmithing, a smith's joint made by inserting the tapered end or tongue of a rod into a V shaped corresponding cleft in the end of another rod for the purpose of making a weld.

2. In carpentry, the joint formed by the *tonguing* of boards.

Tonguing.—The process of forming a fin or ridge along the middle of one side of a board, to fit into a groove in the corresponding side of the next board. This is weaker than the method of plowing a groove in each side of each plank and inserting a *matching piece*, tongue or spline.

Tonguing and Grooving Planes.—In carpentry, planes in pairs, adapted for forming *tongues* and the corresponding *grooves* into which they are received on the edges of boards, etc.

Tonite.—A kind of nitrated gun cotton, produced in a granular form. It is used as a blasting explosive, but is more generally employed in the making of fog signals, distress rockets, etc. On account of its loud report, it has displaced the small cannon formerly carried on shipboard for signaling purposes. Also known as *cotton powder*.

Tonnage.—The measurement of the cubic capacity of a ship. For register purposes, 100 cubic feet equals one ton.

Tool.—An instrument, such as a hammer, saw, plane or file, and the like, used in the manual arts; any instrument used by a craftsman or a laborer at his work; the simplest implements of art; these, when they become complicated in their structure, are termed *machines*, and machines when they act with great power, take the name, generally speaking, of *engines*.

Tool Bag.—A satchel fitted to a bicycle or automobile, carrying tools for repairs and adjustments to the machine, or the tool bag belonging to a plumber.

Tool Board.—In a machine shop, a board supported behind the bed of a lathe as a receptacle for the tools used in turning.

Tool Box.—A chest containing the instruments of service belonging to a mechanic; as, a machinist's tool box; a *tool chest*.

Tool Car.—In railway service, a car for the use of the wrecking or break down crew, being supplied with engineer's, surfacemen's and carpenter's tools, jacks, surgical and other appliances necessary for dealing with an accident.

Tool Chest.—A wooden box fitted with cleats, drawers and other suitable receptacles for a mechanic's tools, more especially a woodworker's, or machinist's outfit; a *tool box*.

Tool Grinder.—An emery wheel, or grindstone, specially constructed and mounted for the grinding of machinists' tools; sluing rests and guides being generally provided so that the various tools may be ground at a uniform and proper angle.

Tool Handles.—The adoption of suitable forms for the handles of tools, cutting and otherwise, is not a matter of indifference, but one which is regarded as almost of exceptional importance by workmen, since few care to use either the tools or the handles used by another man. In most cases the handles are made of wood. Thus, files, chisels, gouges, etc., have handles of wood, bonded with ferrules where the tang is inserted, and the shape of the handles varies in the case of nearly every separate tool, depending upon the way in which it is held.

Tool Holder.—A bar designed to hold and support a small steel cutting tool. Tool holders are supplied for various machine tools, and save the labor of forging, besides greatly diminishing the weight of tool steel required to stock a machine with tools. For boring and many other purposes, a tool in a holder is superior to a solid forged tool.

Tooling.—1. Ornamental embossing, by heated tools, of the leather binding of books, frequently accompanied by gilding of the depressed portions.

2. Stone dressing which shows the parallel marks of the tool in an evenly spaced and symmetrical order.

Toolmaker.—1. A manufacturer of edge tools, hand implements, etc.

2. A manufacturer of engineers' machine tools.

3. A highly skilled mechanic employed in the construction or repair of the general tools in a machine shop; also, the chucks, jigs, etc., used in connection with repetition work.

4. A skilled workman performing the more delicate or important operations of fitting machine parts together at the vise.

Tool Pad.—A handle with adjustable jaws to grip small working tools. A number of these, such as gimlet, awls, turnscrew, etc., are contained within the hollow of the handle, thus affording a portable *tool kit*.

Tool Post.—A circular swiveling post attached to the top of the slide rest, the turning tool being thrust through the slot in the post and clamped by means of a nut or set screw. In large size lathes, the tools are sometimes held down by cross bars secured by studs and nuts. This arrangement is known as a *European tool rest*.

Tool Post Apron.—The *clapper box* of a shaping machine, which permits the tool to *lift up*, on its return stroke.

Tool Rest.—That part of a lathe which holds and directs the tool, having several

adjustments, and being movable by hand or automatically either along the bed or transversely to it.

Tool Room.—That department of a machine shop where shop tools, jigs, chucks, etc., are made and repaired. The department that prepares and keeps in order the tools and apparatus for the shop.

Tools.—On a locomotive, the tools usually carried are *screw jacks* for use in lifting any part of the engine, a *pinch bar* for working the engine along the rails, a crowbar for prying or leverage, spare *chains*, *coupling links*, *tube plugs* for the boiler, *hammers* and *chisels* for iron, a *hand saw* and *axe*, *oil cans* and *oil feeders*, *spanners* and *adjustable wrenches*, together with such firing tools as, *shovels*, *coal picks*, *pokers*, *hoes*, *rakes* and *prickers*.

Tool Steel.—A steel prepared especially for making machine tools, such as lathe cutters, etc.

Tool Temper.—A steel maker's classification of a carbon steel containing 1.25 per cent of carbon. It is suitable for lathe and planer tools and may be welded by the exercise of care and skill.

Tool.—To cause to sound; as, a horn, the note being modified at the beginning and ending very shrill; as, the steam whistle of a tug, giving a special signal.

Tooth.—1. A projecting piece, one of a series, or set, like teeth in a jaw.

2. A similar projecting piece on a machine, whose function is to tear, crumble, crush, cut or mash the material or object supplied to it.

3. A cog on a gear wheel or rack.

4. One of the projecting pointed edges of a file or saw.

5. One of the projecting or piercing points or prongs of a comb, a rake, a harrow or a card.

Tooth Chisel.—A marble worker's tool, resembling the stone mason's *claw tool*, its edge being serrated so that it is suitable for dressing surfaces after the use of the *punch* or point.

Toothed Gearing.—In mechanics, this means that type of gearing which acts by means of teeth or cogs, or modifications of the same, attached to the outer edges of rings as distinguished from gearing of other kinds. Hence, it embraces spur and bevel wheels, mortise wheels, and internal gears.

Toothed Segments.—In foundry practice, large gear wheels are seldom cast in a single ring by reason, first, of the

enhanced difficulty attendant upon the making of large castings, and, second, their inconvenience, as regards transit, fixing and subsequent repair. These are, therefore, commonly cast in segments of six, eight or ten to the circle, and either bolted to their arms or to something which forms a suitable base; as, the shrouding of a water wheel.

Toothless Saw.—A circular disc about three feet in diameter, running at three thousand revolutions per minute, or a peripheral speed of twenty-eight thousand feet. Such discs or saws are used in many places to cut rails.

Top.—1. The highest part of anything; the upper end, edge, or extremity; the upper side or surface; summit; apex; cover; lid; as, the top of the ground.

2. In navigation, a platform around the head of the lower mast of a ship; in modern warships, it is an armored station for riflemen and machine guns.

3. In rope making, a plug with grooves, used to regulate the twist of a rope, when three strands are being laid up or twisted.

4. In wool manufacture, a narrow bundle of slivers of long stapled wool, containing about 1½ pounds. The slivers are made by a pair of combs.

Top and Butt.—In shipbuilding, a mode of working plank which does not maintain its width from end to end. The top of one plank and the butt of the other are worked together so that the two layers make a double breadth of even width.

Top Chord.—The upper horizontal member of a truss; the upper rail of a bridge truss.

Top Cord.—In carding, a narrow strip of wood covered with card-cloth placed above the central drum of a carding engine; also called a *top flat*.

Top End.—The crosshead bearing of a vertical steam engine.

Top Fuller.—The hand forging tool with which a blacksmith makes furrows in a piece of red hot iron when drawing it down. It is usually held by means of a twisted osier or hazel rod, and is struck by the sledge.

Top Gallant Mast.—In navigation, the third portion of a mast.

Top Heavy.—Having the top or upper part too heavy for the lower part.

Topmast.—The second portion of a mast, carrying the topsail yards and sails.

Topographical Survey.—A mapping of a country with absolute accuracy and minuteness of detail, made with elaborate instruments and repeated careful observations, as distinguished from a *reconnaissance* or hurried survey.

Topping.—1. In saw filing, the reduction of the tops of saw teeth to a uniform level previous to sharpening. The topping is necessary to insure the simultaneous cutting action of all the teeth, and is performed by passing a file over them once or twice, in a longitudinal direction, previous to sharpening. In circular saws, it is done by holding a piece of stone to the tops of the teeth, while the saws are revolving.

2. In machinist work, the breaking off of the unground and hollow top portions of steel ingots, which have sunk or become hollow in the center.

Top Rail.—1. The upper cross bar of the frame of a planing machine or boring mill.

2. The upper longitudinal member of a bar frame in a locomotive.

Top Rake.—The angle at which the upper face of a cutting tool is formed below the horizontal; this, with the front rake or clearance, forms the cutting angle of the point.

Top Runner.—In a pair of millstones, where the upper one revolves, the lower remaining stationary.

Top Swage.—The upper half of a set of swaging tools by means of which a smith dresses or smooths cylindrical work. It is held in the smith's hand by means of a twisted osier or cane and is struck by the hammerman with his sledge.

Topsy Turvy.—In an inverted posture; with the top or head downward; upside down; as, to turn a carriage *topsy turvy*.

Torch.—1. In construction, a flaring lamp producing a bright light which cannot easily be blown out; it usually consists of a large lamp burning naphtha or some other volatile hydrocarbon.

2. Any portable lamp with its burner on top of the container, which has a vertical flame, not requiring a chimney to shield it.

3. A blow-pipe lamp burning gasoline, etc., employed by plumbers to heat wiped joints, or by painters to burn off old paint; also for blow-pipe brazing, etc.

Torching.—In building, pointing or cement applied to the underside of slate or tile roofs.

Torpedo.—A canister or series of canisters containing nitroglycerin, which is used to open up the strata around a drilled oil well. The torpedo is lowered to the bottom of the hole on completion, and is exploded by means of a *squib* or *go-devil*.

2. A detonator or cartridge placed upon a rail, and set off by the pressure of the wheels. Used as a fog signal, or as an emergency signal or alarm to the engineer of an approaching train.

Torpedo Stern.—In navigation, a type of stern first adopted on torpedo craft and subsequently on motor boats. It is a broad, rounded stern without counter or overhang, the deadwood being also cut away. The object is to lessen the settling by the stern, experienced in small vessels driven by high powered engines, and to eliminate the formation of a vacuum by the screw propellers.

Torque.—The turning effort applied to a shaft, as that of a steam engine, by the various cranks. The term originated in electrical engineering.

Torsiometer.—An instrument to measure the stress to which a bar is subject when in torsion, or under twisting strain.

Torsion.—1. In mechanics, that force with which a thread, wire, or rod of any material, returns or tends to return to a state of rest after being twisted.

2. The act of turning or twisting or the state of being twisted.

Torsional.—Of or pertaining to torsion; as, *torsional* force.

Torsional Stiffness.—In mechanics, that amount of rigidity of a shaft by which it is enabled to resist, not simply such strains as would produce actual twisting off, but also such excessive vibration as would prevent it from doing its work with due steadiness.

Torsional Strain.—The effects set up in a body by a torsional stress which tends to rupture it by *twisting* one fiber around another.

Torsional Strength.—Resistance to being twisted or wrenched off, in a direction about its axis; as, in case of shafting.

Torsion Balance.—A weighing machine for delicate work, in which the beam is pivoted on fine wires instead of knife edges. As the connection is rigid, the displacement of the beam puts a torsional force on the wire, hence the name.

Toss.—To lift or throw up with a sudden or violent motion; as, a ship tossed on the waves.

Total Heat.—"Total heat," a term used in calculations; it represents units of heat when the weight of the steam is one pound. It is the sum of the heat units in the water, above 32° Fahr., and the latent heat of the steam.

Total Pressure.—The pressure of steam above vacuum, also called *absolute pressure*.

Tote.—1. To carry or bear.

2. The entire body, or all; as, the whole tote.

Tote Box.—A shop term, meaning a box to carry small articles about the shop; it is derived from the word tote, which means to bear.

Totter.—To shake so as to threaten to fall; to be unsteady.

Touch.—1. To come in contact with; to hit or strike lightly against.

2. To perceive by the sense of feeling.

3. To mark or delineate with touches, to add a slight stroke to with pencil or brush.

4. In navigation, to touch bottom lightly and without damage; as, a vessel in motion.

5. In shipbuilding, the broadest part of a plank worked top and butt, or of one worked anchor stock fashion; that is, tapered from the middle to both ends.

Tough.—1. Having the quality of flexibility without brittleness; capable of resisting great strain; able to sustain hard usage; not easily separated or cut.

2. Material, as iron, is said to be "tough" when it can be bent first in one direction, then in the other, without fracturing. The greater the angles it bends through (coupled with the number of times it bends), the tougher it is.

Tough Brass.—In metals, brass which is suitable for engine bearings and wearing parts. It is a vague term which might mean either a superior quality of brass or simply gun metal.

Tough Hardening.—A method of increasing the toughness and tenacity of carbon steel, by quenching at a low yellow heat, reheating to about 750° Fahr., and cooling slowly. This increases the tensile strength nearly twenty-five per cent over that attained in its annealed state.

Tourniquet.—1. In mechanics, a device for stopping leaks.

2. In hydraulics, a reaction engine or wheel.

3. In case of *first aid* to the injured, the *tourniquet bandage* is used to stop the flow of blood from a wounded limb. The tourniquet is

wound around the limb, the ends tied together, and pressure applied by twisting it up by means of a stick, etc., causing a compressing action on a pad (or substitute) over the artery.

Tousle.—To put into disorder: to tear; to tumble.

Tow.—1. A rope by which anything is towed; a towline or towrope.

2. That which is towed, or drawn by a towline; as, a raft or a barge.

3. The coarse and broken part of flax or hemp, separated from the finer part by the hatchel or swingle.

Towards.—1. In the direction of; to.

2. With respect or reference to; regarding; concerning.

3. Near; about; approaching to.

Towboat.—A steam tug; a boat for towing, usually larger and more seaworthy than the ordinary tug.

Tower.—1. A high building or a portion of a building which is considerably elevated above the remainder. Towers were originally built for purposes of defence or of observation, and in churches to serve as bellfries.

2. A high structure used for carrying off the unhealthy fumes caused by the manufacture of chemicals; a similar lofty building for making shot. Also called a *shot tower*.

Tower Bolt.—In carpentry, a stout sliding bolt used to secure a door; its plate is fastened to the door frame by screws, not being recessed or mortised in any way.

Towing Path.—The track on the side of a canal for the draft animals. Also called *tow path*.

Towing Rope.—A hawser by which to tow or draw vessels or canal boats.

T Plane.—A plane used by carriage makers and coach builders. Its stock is shaped like a letter T, the foot holding the iron; this permits it to be used in routing out a groove or furrow in the work.

T Plate.—1. In carpentry, a T-shaped plate; as, for strengthening a joint in a wooden frame work.

2. A carriage iron for strengthening a joint, such as at the intersection of the tongue and cross bar; the coupling pole or reach.

Tracer.—1. In drawing, one who traces or copies drawings.

2. An instrument for drawing lines of uniform breadth; a form of pen having two metal blades, the ends of which are adjustable as to distance, by means of a screw; often fitted to one leg of a compass.

3. A dotting machine or the like; as, for marking leather.

Tracery.—The geometrical arrangement of bars in a window or archway so as to make a pleasing design.

Traces.—Openings, about two inches wide, left between bricks, when stacked in a kiln, to permit the heated gases to be drawn through the piles, in order to burn them.

Tracing Cloth.—A smooth transparent linen, glazed on one side, and rough on the other, generally used to copy drawings for shop use. The colors are applied to the rough side, as also are pencil marks, the glazed side being suitable for ink alone. The cloth is generally made in rolls twenty-one yards long and from eighteen to forty-two inches wide.

Tracing Paper.—In drawing, fine tissue paper made transparent by the addition of linseed oil and turpentine, or a similar medium, such as turpentine and Canada balsam.

Track.—1. On a railroad, the permanent way; the rail.

2. In navigation, to draw along continuously; as, a vessel by a line; to tow.

Track Bolt.—In a railway, the same as snap headed bolt, with square or oval neck, used to secure the joints of rails. Also called a *fish bolt*.

Track Hanger.—A hanging support for an overhead railway, upon which a *traveling crane* or similar appliance may run. It is generally used in connection with a monorail on which run carrier trolleys, by means of which weights are transported from one department of a plant to another.

Track Inspector.—In railways, an official having charge over ten to twenty gangs of surfacemen, or track hands, and responsible for maintenance and repair of the permanent way in his district.

Track Raiser.—In railroads, a lifting jack for raising rails which have become sprung below the proper level.

Track Sander.—On a locomotive, a device for applying sand between the driving tires and the rail, thus increasing its adhesion.

Track Tanks.—On a railway, the troughs between the lines for the *water pick up* arrangement.

Track Walker.—In railways, a watchman over the railway line, who has to patrol his district twice daily to observe the state of the track or permanent way.

Tract.—1. Something drawn out or extended; expanse.

2. A region or quantity of land and water, of indefinite extent; an area; as, an unexplored *tract* of land.

Traction.—1. The act of drawing, or state of being drawn.

2. The act of drawing a body along a plane by motive power; as, the drawing of a train of cars by a locomotive, or the drawing of a wagon by a horse.

Traction Engine.—1. A self-propelled agricultural steam engine, capable either of hauling vehicles along common roads, or of driving machinery, such as, threshers, etc. When fitted in addition with windlass for manœuvring a steam plow, this type of engine is usually known as a plow engine.

2. A locomotive for drawing vehicles on highways.

Tractive Power.—In mechanics, the power of pulling; the power used in towing a boat or pulling a car.

Tractive Resistance.—In physics, that proportion of the actual weight which has to be overcome in order to effect haulage; on a railroad it depends upon the speed, gradient and surface; on a railway it varies with the speed, inclination, and rate of curvature, also is affected by the state of the wind.

Tractor.—A motor vehicle designed to haul other road vehicles, in similar manner to a traction engine or a locomotive.

Trade.—1. In mechanics, the business which a person has learned, and which he engages in for procuring subsistence, or for profit; especially mechanical employment; as, the trade of a carpenter or mason.

2. To buy and sell; to be engaged in the exchange, purchase or sale of goods, wares or anything else.

Trademark.—An arbitrary symbol affixed by a manufacturer or merchant to an article of manufacture. The principal purpose of a trademark is to guarantee

the genuineness of a product. It is, in fact, the commercial substitute for one's autograph. In all ages it has been used to denote origin, and thus to protect the purchaser as well as the vendor. All countries protect the integrity of trademarks, and nearly all civilized nations have treaties securing reciprocity of protection.

Trades Union.—A combination among workmen for the purpose of maintaining their rights and privileges with respect to wages, hours of labor, customs, and the like.

Trade Winds.—Winds blowing steadily in the same direction for a long period, so called on account of their assistance to navigators and consequently to trade.

Traffic.—1. Commerce, either by barter or by buying and selling; interchange of goods and commodities; trade.

2. The business done upon a railway, steamboat line, etc., with reference to the number of passengers or the amount of freight carried.

3. The passing by, through or upon a public highway by persons or vehicles.

Tragacanth.—A kind of gum used in a drawing office, procured from a shrub; it comes in a hard, whitish or yellowish flakes or filaments, and is nearly insoluble in water, but slowly swells into a mucilaginous mass, which is used as a cheap substitute for *gum arabic*.

T Rail.—A kind of rail for railroad tracks, so that a section of it resembles the letter T.

Trail.—1. Anything drawn out to length; as, a *trail* of smoke.

2. A track left by man or beast.

Trailer.—1. A small carriage designed to be connected to a bicycle, so as to be drawn by it, usually carrying one passenger.

2. An extra car drawn by the motor car on street railways or tramways; the term applies equally, whether steam, electricity or cable, be the means of propulsion.

3. A vehicle adapted for hauling by a tractor or road locomotive, either singly or in a train.

Trailing Water.—The operation of drawing water a long distance through pipes, by means of suction. As long as the total height lifted, plus the friction in the pipe, does not exceed a head of 25 to 26 feet, water can be trailed a very great distance. The only difficulty is possible leakage at the pipe joints, which impairs the vacuum.

Trailing Wheel.—A locomotive wheel behind or at the rear of the driver.

Train.—1. Something long drawn out; a series or succession of similar objects following one another; a set of parts arranged in a series for a definite operation.

2. A line of welged gunpowder or other combustible for setting fire to a blasting charge, mine, or other explosive.

3. The unit of railway transportation; a locomotive and a number of cars conveying passengers or freight, or empty vehicles, moving from place to place at a definite time, under a timetable or to special orders.

4. A series of rolls for the production of metal bars or plates, the various pairs being connected and worked as one system.

5. A number of toothed wheels arranged in series and successively meshing with each other, to effect either transmission or modification of motion or both.

Train Dispatcher.—In railway operation, one whose duty it is to see that the trains of a railroad system leave their stations at their proper time. He keeps a record of the movements of trains in his division and has the power of giving orders for their movements.

Trainmen.—A general term embracing all those employes of a railway company on a specified train.

Train of Gearing.—In mechanics, an arrangement of wheels and pinions by which power is gained in the one direction or speed gained in the direction opposite. In a train of gearing, the power or speed of each wheel is inversely as its radius, diameter, circumference, or number of teeth, and the product of the series is in *geometrical ratio*; also called *train of wheels*.

Train Oil.—In lubrication, sometimes improperly called a fish oil. It is produced from the blubber of the *right whale*, hence an animal oil.

Trajectory.—1. In physics, the path described by a projectile moving under given forces; as, by a cannon ball in flight acted upon by gravity and the resistance of the air.

2. In mathematics, a curve or surface intersecting a system of curves or surfaces at a constant angle.

Tram.—1. In weaving, a silk thread formed of two or more threads twisted together, used especially for the weft or cross threads of the best quality of velvets and silk goods.

2. In mining, a small four wheeled car used in transporting the coal from the working face.

Trammel.—1. A beam compass.

2. In drafting, an *ellipsograph* consisting of a cross with two grooves which form guides for two pins on a beam compass. The pencil on the beam is directed in a prescribed elliptical path as the pins slide in the grooves. Each pin travels in its own groove, and makes four strokes for each revolution of the pencil. This double reciprocation has occasioned its adoption in machines which require speedy motion.

Trammer.—In mining, a man or boy who pushes trams or small cars along the roads of a mine; who drives ponies drawing the tubs, or who acts as driver of a train of cars hauled by continuous rope haulage.

Tramp.—1. To tread upon forcibly and repeatedly; to trample.

2. To travel or wander through the country.

3. To cleanse, as clothes, by treading upon them in water.

4. A tool for trimming hedges.

5. A plate of iron worn to protect the sole of the foot, or the shoe, when digging with a spade.

Trample.—1. To tread with force and rapidity; to stamp.

2. To treat with contempt; with or upon.

3. The act of treading under foot; also the sound produced by trampling.

Trampot.—In millwrighting, the support in which the foot of the spindle is stepped. The arched trampot is used for straddling the driving shaft. Where bevel gear is employed, the more common form has a movable center adjustable by means of four set screws.

Tram Road.—A road prepared for easy transit of trains or wagons, by forming the wheel tracks of smooth beams of wood, blocks of stone, or plates of iron.

Tram Staff.—In milling, a miller's straight edge which is employed to test the squareness of the spindle with the face of the stone, etc.

Transaction.—The doing or performing of any business; management of any affair.

Transcript.—A written copy; that which has been transcribed, a writing made from and according to an original; a writing or composition consisting of the same words as the original.

Transfer.—To convey from one place or person to another; to transport or remove to another place or person.

Transfer of Heat.—In steam engineering, refers specially to the transmission of heat from a boiler furnace to the water within. Rapidity of circulation is necessary to prevent destructive overheating of the plates, which would soon happen if the heat transferred from the furnace were not carried away rapidly by the water. The coating of deposits of the feed water and sooty accumulations interfere with the transmission of heat. Thin plates conduct more rapidly than thick ones, and the rate of transmission area is more efficient than tube area, because of the greater concentration of heat there. The rate of transmission signifies the number of heat units transferred per hour, but the amount of heating surface will vary in different types of boilers.

Transfer Paper.—Paper prepared so that it will transfer its coloring matter to the surface upon which it is laid. It is made by greasing an ordinary white paper with lard or tallow, then rubbing in any dry pigment, such as lamp-black, afterwards dusting off superfluous color. The transfer paper is then laid face down on a sheet of white paper, the print or design to be copied on top of all. This last is gone over with a stylus or pencil, and the lines will be found to have transferred themselves to the blank paper, from the transfer sheet.

Transform.—To change into another substance; to transmute; as, the alchemists sought to transform lead into gold.

Tranship Shed.—A goods or freight depot at an important railway center, where numerous small consignments from various directions, and proceeding to one common point, are collected to make up car load quantities.

Transit.—1. The act of passing; passage through or over.

2. A telescope capable of movement in a vertical plane only, it being so mounted that it lies in the meridian of the place where it is set up. It is used to measure the time of passage of the sun or other heavenly body, for the purpose of ascertaining local time, or (in first-class observatories) for determining the right ascension of stars.

3. In engineering, the surveyors' transit is a portable instrument of the theodolite kind, designed for measuring both horizontal and vertical angles. It is provided with horizontal and vertical graduated circles, one or two levels, and a compass, and is mounted upon a tripod stand.

Transition.—1. In process of development or passage from one state, condition or style to another.

2. The act of passing from one state of development to another.

Transition Piece.—In sheet metal working, a moulded piece forming a connection between two different sections; for instance, square at the base and octagonal at the top, or changing from round to hexagonal.

Translucent.—Transparent; clear; transmitting rays of light without permitting objects to be distinctly seen.

Transmission.—To send through, or across; transfer. Up to a certain limited distance, the useful effect of the energy created at a certain point, can be best and most economically transferred by *belting* of various materials, *pulleys* and *shafting*. For greater distances there are four principal methods in use for the transmission of power: (a) electricity, (b) water (hydraulic power), (c) air (pneumatic power), (d) wire rope.

Transmission of Power.—The conveyance or transmission of energy from one point to another, more especially from a convenient central source of power to the point where it is desired to be applied. For short distances, shafting, belts, pulleys, ropes, etc., are employed; medium distances may be covered by wire rope transmission; longer distances may need hydraulic power, compressed air, or electricity. Each type of transmission has its advantages for certain circumstances.

Transmission Rope.—Rope specially made to resist the severe strains imposed upon it when transmitting power. It may be either manila or steel wire, according to circumstances.

Transmit.—To cause to pass over or through; to communicate by sending; to send from one person or place to another; as, to transmit an order.

Transom.—1. In building, a horizontal piece framed across a doorway or a double window.

2. In shipbuilding, a beam bolted across the stern post, supporting the after end of a deck and giving shape to the stern. The third, second and first transoms are, referring to them in the using order, below the deck transom; the *wing transom* is the sill of the gun-room ports; the *helm transom* is at the head of the stern post and forms the head of the ports.

3. In surveying, the vane of a cross staff.

Transparent.—So penetrable by light that it may be seen through; as, clear glass.

Transport.—In navigation, a ship or vessel employed for transporting, especially for carrying soldiers, warlike stores, or provisions, from one place to another.

Transportation.—Carrying or conveying from one place to another; removal; conveyance; the act of transporting.

Transpose.—To change the place or order of; to substitute one for the other; as, to transpose letters in spelling.

Transversal.—1. A line drawn across several others, cutting them all, a straight line being generally understood.

2. A transverse or horizontal series of numbers taken from others tabulated or arranged in vertical columns. A horizontal line in a table of numbers would be a *transversal*.

Transverse.—Crosswise or in the direction at right angles to the length of anything; lying or being across anything; the opposite to longitudinal.

Transverse Axis.—In geometry, the major or longer axis of an ellipse or oval.

Transverse Section.—A drawing representing the sectional elevation of any object, structure or machine, upon a transverse plane at right angles to its length.

Transverse Strength.—Resistance to being bent or broken across by a force, perpendicular or oblique to its length, as in common beams and joists.

Trap.—1. In plumbing, a device in a pipe designed to retain at a fixed point a body of liquid that is replaced whenever the trap is used, and, while not hindering the descent of waste matter, seals the pipe at that point against a return flow; as, of poisonous gases. These traps are now often provided with a ventilating pipe to prevent syphoning.

2. A steam trap, or device for expelling water of condensation from steam pipes.

3. A device for catching anything, analogous to the snare or trap for animals.

Trapdoor.—A lifting or sliding door in a floor, roof, ceiling, or stage.

Trapezium.—In geometry, a quadrilateral having no two sides parallel.

Trapezoid.—In geometry, a quadrilateral in which two sides are parallel.

Trass.—A volcanic earth found in those parts of France and Germany where there are extinct volcanic regions. Trass is a natural *hydraulic cement*, and hardens under water.

Travel.—1. To move in space; as, sound *travels* more slowly than light.

2. In mechanics, to move automatically in a fixed course; as, a lathe carriage or a piston; the distance through which a reciprocating part *travels* or moves; the term is often

used in reference to the linear motion of a slide valve; as, the *travel* of a slide valve of an engine.

Traveler.—1. In navigation, a metal ring, or thimble, running freely on a rope, rod or spar.

2. A framework or girder carrying a lifting crab or crane, and able to travel along elevated rails. A *traveling crane*.

3. A small open metallic ring or loop, traveling around a circular race in a cotton spinning machine, delivering the *yarn* from the rollers to the bobbin on the spindle. It is used instead of a fly frame.

Traveling.—1. In mechanics, constructed with a part that travels; as, a *traveling oven*, as found in mechanical bakeries. Also portable; movable.

2. Running or sliding as a ring or thimble; as, a *traveling guy*, or *traveling gauntry*.

Traveling Crane.—A crab or winch mounted on a girder which spans a workshop, or the like. The crab can move sidewise upon the traveler, while the latter runs on rails up and down the building. In some instances, the traveling crane carries its own boiler and steam cylinders, in others, the three movements are taken care of by separate electric motors. Other plans are a drive by endless cotton or hemp ropes, from the shop shafting, or through a lay shaft and worm gearing, like the traverse shaft on a lathe.

Traveling Derrick.—A derrick mounted on a carriage; usually moved by power or horses; a *house derrick* is moved by hand.

Traveling Engineer.—One who accompanies a running locomotive engineer to instruct him.

Traveling Grate.—In a steam boiler furnace, an arrangement of firebars, not unlike a Venetian blind; the bars form an endless belt around one sprocket wheel and shaft at the front, and another near the bridge, motion being imparted to the different grates from an auxiliary engine. As the belt of grate bars travels toward the back of the furnace, it removes the freshly coked fuel into the hotter parts of the fire, promoting combustion and smoke consumption, while ashes, clinker, etc., are dumped into a space between the back of the grate and the front of the bridge, whence they are raked by hand.

Traveling Head Shaper.—One of the usual type, in which the ram, etc., traverses over the work, instead of the work being fed under the tool, as in a pillar shaper.

Traveling Post Office.—A railway car arranged for dealing with mails *en route*.

The cars are provided with hooks and stretchers for bags and pouches, and pigeonholes for sorting the mail matter. Apparatus is also fitted for taking in and putting off mail pouches while the train is in motion.

Traverse.—1. To move across.

2. In mechanics, a part; as of a mechanism that traverses or crosses; as, the tool *traverses* the work.

Traverse Drill.—1. A drill for boring slots. The drill or the work has a lateral motion after the depth is attained.

2. One in which the drill stock has a sideways travel for adjustment.

Traverser.—In railway engineering, a device to shift a railway car or locomotive from one line of rails to another line parallel thereto. It is a platform supporting a section of the line of rails, and supported on wheels, which traverse on a transverse line of rails at a lower level.

Traversing Jack.—A screw jack, used in railway working, which has the jack mounted on a traversing table or base, whose leading screw engages with a nut in the base of the jack. By this means the piece lifted may be moved to and fro as soon as the jack has taken its weight.

Traversing Pulley.—A pulley so arranged as to traverse upon a rope or rod. It is used in communicating, by a rope, between a stranded ship and shore; in building construction, to convey bricks or other building materials on to a scaffold or building; in conveying freight upon a track wire; in supporting barn and warehouse doors, which *slide* open instead of swinging on hinges.

Traversing Table.—In a railroad or car works, a movable platform running on rails at right angles to the doors of a rectangular locomotive shed, to transfer engines between the running lines and any desired compartment or "stall". The object of the traversing table and rectangular buildings is to economize space as compared with a roundhouse.

Trawl.—A bag shaped net weighted and *trawled* or drawn along the sea bottom; a long line towed astern baited with many hooks.

Tread.—1. The horizontal portion of a step; that on which the foot presses.

2. The part of a wheel that bears upon the road or rail.

Treadle.—In machinery, a foot lever connected by a rod to a crank to give motion to a lathe, sewing machine, circular saw, or other mechanism.

Tread Mill.—A mill worked by persons treading on steps upon the periphery of a wide horizontal wheel. It is used chiefly as a means of prison discipline. Can also be used with animal power.

Tread Wheel.—A horizontal wheel furnished on its exterior surface with foot boards on which persons may tread, and so cause the wheel to revolve.

Treasurer.—One who has charge of funds and authorized to receive, care for, and pay out the cash belonging to a company.

Treasury.—The place of deposit and disbursement of any collected funds.

Treatment.—The manner in which a task is managed; manipulation; manner of mixing or combining, and the like; as, the treatment of substances in chemical experiments.

Tree.—1. A plant which is woody, branched, and perennial, like a shrub, but of larger size, generally exceeding ten feet in height, and of a single stock instead of a cluster.

2. In wagon building, the bar on which the horse or horses pull.

3. In shipbuilding, a bar or beam in a ship; as, *chess tree*, *cross tree*, *rough tree*, *waste tree*, etc.

4. In milling, the bar supporting a mill spindle.

Tree Nail.—1. In shipbuilding, a cylindrical pin of hard wood used for securing planking to the frames, or parts to each other. Teak and oak are much used for this purpose.

2. A cylindrical piece of wood, compressed in a machine, and forced into holes in a railway tie or sleeper, and into which the spikes for the chairs are driven. Moisture swells the tree nail and all is firmly gripped together.

Trefoil.—1. In architecture, an ornament consisting of three contiguous circles, resembling the three leaved clover or *trefoil*, or the shamrock.

2. A window or light, or opening in tracery, resembling the three leaves of a trefoil plant, being composed of three cutting circles.

Trellis.—1. In carpentry, a light lattice work of wood.

2. A summer house or other structure constructed mainly of *trellis work*.

Trembler.—A vibratory device used in connection with the jump spark method of electric ignition for gasoline engines; a vibrating blade or spring, actuated by the magnet of the induction coil, connects and interrupts the primary circuit, so that the coil produces a shower of rapid sparks between the points, rather than a single flash at the time of ignition.

Trench.—To cut or dig; as, a ditch, a channel for water, or a long hollow in the earth, as, we trench land for draining.

Trencher.—1. One who trenches, or digs ditches.

2. A wooden plate or dish.

Trench Machine.—An excavating machine, not unlike a ladder dredger on wheels, which digs trenches for pipe laying, sewers, irrigation, etc.

Trench Plates.—In furnace heating, these are iron covering plates, fitted to the cold air inlet trench, or acting as deflectors in the inner chamber of the firepot.

Trench Plow.—A kind of plow for opening land to a greater depth than that of common furrows.

Trend.—1. The direction or course in which anything appears to be proceeding; as, the trend of circumstances.

2. Inclination in a particular direction.

Trend of an Anchor.—In navigation, the lower end of the shank of an anchor, being the same distance on the shank from the throat, that the arm measures from the throat to the bill.

Trepan.—To bore metal in a manner analogous to the surgical operation of trepanning, by removing the material in circular discs. Tube plate holes are generally bored in this way by means of a cranked tool set in a holder, working in a guide hole already drilled.

Trestle.—A movable frame or support for anything; as, scaffolding, consisting of three or four legs secured to a top piece, and forming a sort of stool or horse, used by carpenters, masons, and other workmen; also, a kind of frame work of strong posts or piles, and crossbeams, for supporting a bridge, the track of a railway, and the like.

Trestle Board.—A board used by architects, draftsmen, and the like, for drawing designs upon; so called because formerly supported by trestles.

Trestle Bridge.—In civil engineering, one in which the bed is supported upon framed sections which rest on the soil or river bed. Used largely in railroad and temporary construction work.

Trestle Trees.—In shipbuilding, two strong bars of timber, fixed horizontally on the opposite sides of the masthead, to support the frame of the head.

Trestle Work.—A viaduct, pier, or scaffold, resting on numerous posts or piles, which are usually connected by crossbeams.

Tret.—A former allowance to purchasers for waste due to transportation, consisting of four pounds in each 100 left after deducting tare.

Trevat.—A weaver's cutting instrument for severing the pile threads of velvet.

Trevithick, Richard.—Born 1771, died 1833. An English mechanical engineer, the first to apply steam for drawing loads on railroads and hence called the "father of the locomotive." He was especially noted for his inventive genius and herculean strength. He made various improvements in pumps; invented a double acting water pressure engine (1800), a steam road carriage (1801); improved the locomotive for operating on rails (1808); adapted the steam engine to mining, and made many experiments in engines for dredging, marine propulsion and other purposes.

Trial.—1. A proving or testing by experience or use; as, the *trial* of an invention.

2. An effort to do something; as, to make the trial.

3 Examination by a scientific test; as, of chemicals, metals, etc.

Trial and Error.—In workshop practice, a method of obtaining correct results in the production of pieces of mechanism and of tools, commonly resorted to in workshops. It simply means that when the best results possible are obtained with one set of tools, or with one method of construction, that another set of tools, or another method of construction is resorted to, in order to detect the errors left uncorrected by the previous method. Thus, the production of surface plates or of straight edges is essentially one of trial and error. The centering of work in the lathe with chalk is done by a method of trial and error.

Triangle.—1. In mathematics, a figure bounded by three lines, called *sides*, and having consequently three angles, hence the name of the figure.

2. A flat drawing instrument shaped like a right angled triangle; used with the T square

for making perpendicular, parallel or diagonal lines; also in cross hatching, etc.

3. On shipboard, a *gin* or shears made of three spars lashed together at the top.

Triangle of Forces.—In physics, the triangular figure which graphically represents the magnitude and direction of *three forces in equilibrium* which are lying in one plane.

Triangular Scale.—In drawing, a drawing scale having three faces, each being differently divided. The dimensions on each side can therefore be set off directly on the paper without resorting to the use of compasses, or without having separate scales on hand.

Triangulation.—The process of surveying for the purpose of making maps. A base line is set out and measured, and on this is set out a system of triangles, each triangle serving as the base for a fresh series. By these *triangles* the exact location of any spot is determined, and the work is checked for accuracy at each step. The measurement of the first base, which is on some open level tract, requires the utmost precision.

Triblet.—1. A tapering mandrel on which rings, nuts, etc., are formed or forged.

2. The mandrel or core used in drawing lead pipe.

Trice.—To haul or tie up by means of a rope.

Tricycle.—A very light vehicle with three wheels, propelled by its rider through treadles. The frame is tubular, and the wheels have wire spokes; as, in a bicycle. Many of these vehicles are fitted with a body or basket, behind the rider, fitting them for delivery of parcels, thus converting the tricycle to commercial uses.

Trident.—In assaying, a three pronged fork, used to remove the annealing iron from the muffle.

Trigger.—1. A catch which, being drawn back, liberates the hammer of a gun, lock, or the spring of a machine.

2. In shipbuilding, a piece of wood placed under a dog-shore to hold it up until the time for launching. The dog-shore butts against cleats on the bilgeways, and is knocked away when the signal is given for launching.

Trigonometry.—That portion of geometry which has for its object the measurement of triangles. When it treats of plane triangles, it is called *plane trigonometry*; when dealing with angles on a sphere, as in navigation, it is termed *spherical trigonometry*.

Trim.—The carpentry finish applied to a building; as, *hard wood trim*.

Trimmer.—In moulding, the workman who cleans gates, sprues, and sand, from the casting after it leaves the mould.

Trimmer Chisel.—A blacksmith's cutting tool not unlike a *hot set*, but with its handle welded to it, making it resemble a hatchet. The edge is made convex, so that it can be slid easily over the work; if the edge be concave, the tool is known as an *arched chisel*.

Trimming.—In foundry, the act of cleaning sand, fins, runners and gates from castings after they have left the mould, also known in various parts as *chipping*, *dressing*, or *jettling*.

Trimming Machine.—1. A species of lathe for trimming the edges of stamped hollow ware, such as, sheet metal pans. The article is chucked on the rotating head, and while one portion of the edge is trimmed off smoothly by a cutter, a part, already trimmed, is turned over, forming a bead around the wire, by which the rim of the pan is stiffened.

2. In boot making, a machine for trimming the edges of uppers.

Trimings.—Syphons or worsteds of woolen fiber, that draw oil by capillary attraction from the reservoirs and drop it down the ducts leading to the bearings.

Trip.—1. To intercept, so as to cause one to fall.

2. To occasion a sudden fall by releasing or removing supports.

Trip Gear.—The arrangement of levers, latches, etc., by means of which the admission valves of Corliss steam engines are released from the valve gear, so as to effect a sudden cut off by the aid of springs, steam, air pistons, etc. The position at which the valves are *tripped* is determined by the governor, according to the load.

Trip Hammer.—A tilt hammer whose fall is permitted by a trip, or which is given motion by means of a cam, wiper or wheel tooth, which depresses the tail of the hammer helve and then suddenly releases the raised weight.

Triple.—1. Consisting of *three things* united or of three parts; threefold; multiplied by three.

2. To make threefold the quantity or number of; to increase in size and number so as to be three times as large.

Triple Barrel Pump.—A pump having three barrels connected with a common suction pipe. The pistons are operated by a three throw crank, the cranks being at an angle of 120° , so that each piston is always at a different part of the stroke from either of the others, and being double acting, produces an almost uniform flow. Also called *triplex pump*.

Triple Draught Tubular Boiler.—This is the horizontal tubular class, and is different from the well known type only in the arrangement of the tubes, which secures the passage of the products of combustion, *under the bottom of the boiler, and then through the same shell twice; forward through a part of the tubes, and backwards through the remaining ones.* This excellent boiler is an invention of the late William Hennessey, of Springfield, Mass.

Triple Effect.—Also written, *triple effect*. A distilling apparatus, worked in three stages under varying degrees of vacuum. The vapor from the first vessel vaporizes the contents of the second chamber, which in turn vaporizes the liquid in the third effect; all drains going to the condenser.

Triple Expansion.—A steam engine in which the expansion of the steam is effected in *three stages* by successive cylinders, known as the high pressure, intermediate, and low pressure. The cranks are usually at equal angles of 120° ; thus a very uniform turning effort is obtained, and the temperature and pressure range of each cylinder is not very large; these factors, together with the high rate of expansion, make a very economical engine.

Triple Geared.—Said of a machine in which the power or speed is multiplied by gearing. A triple geared lathe, in addition to the ordinary back gearing, has another train of wheels from the mandrel to the rim of the face plate, thus further diminishing its velocity proportional to that of the belt.

Triple Geared Lathe.—A lathe having triple gearing.

Triple Riveting.—In boiler construction, three rows of rivets combining the arrangements of chain and zigzag riveting.

Triple Screw.—In navigation, in some fast passenger vessels, three separate sets of machinery and propellers are provided to lessen chances of total disablement; and to provide units of convenient dimensions.

Triple Valve.—In railway engineering, a valve device of the Westinghouse air-brake, consisting of a body or case called the triple valve body, which has connection with (1) the brake pipe, (2) the auxiliary reservoir, and (3) the brake cylinder, in which a slide valve is operated by a piston, so that when the pressure of the air in the brake pipe is increased, the auxiliary reservoir is charged and the air in the brake cylinder is released to the atmosphere, and so that, when the air pressure in the brake pipe is reduced, air from the auxiliary reservoir is discharged into the brake cylinder, for applying the brakes.

Triplex Block.—A powerful pulley block, invented by Weston, who introduced the differential block. The load is lifted through triple spur gearing, which is quicker than worm or differential gearing; the descent is controlled by a brake, consisting of numerous metallic discs mounted on the block sheave spindle, the strain on the chain pressing these against each other and the casing. This permits the weight to be lowered with great delicacy and entirely at the will of the operator.

Tripod.—A three legged support for a surveyor's theodolite or compass, plane table, or similar object.

Tripod Bearings.—More generally known as *three point bearing*. A method of attaching machines to their foundations, etc., so that they are resting upon three points only, this preventing rocking, which is liable to take place if the object rests on four feet.

Tripod Jack.—In tools, a screw jack which is supported on a tripod of three iron legs, and often used in locomotive shops.

Tripper.—1. A stop which engages with the latch of a Corliss or similar valve gear, tripping it at a point determined either by the governor or by hand.

2. The trigger set to release the monkey or ram of a pile driver.

3. A tilting or tipping device, arranged at a desired spot along a belt conveyer, causing the belt to tilt and discharge its contents; as, of grain.

Trisect.—To subdivide into *three equal parts*; as, an angle, in plane geometry.

Trolley.—An electric collector, consisting essentially of a pulley or similar device riding on an overhead wire, used to transmit electricity to the motors of railway vehicles.

Trolley Car.—An electric railroad car in which the current for the motors is taken from an overhead wire by means of a trolley with grooved wheels, which is held up against the wire by a flexible pole. The wires

from the contact wheels pass down the pole to the car controller and thence to the motor, the return circuit usually being through the rails.

Troll Plate.—In machinery, a rotating disc employed to effect the simultaneous convergence or divergence of a number of objects; such as, screw dies in a stock, or the jaws of a universal chuck.

Trommel.—In mining, a form of buddle or machine for separating the richer portions of slimes from the worthless.

Trompe.—In hydraulics, a primitive appliance for creating an air blast by means of a high fall of water; where the falling of water down a pipe draws air through openings, in similar manner to that observed by all in a wash basin or bath, and carrying it along with it, delivers a steady and equal blast at the foot of the column.

Troostite.—A state or condition of steel particles observed when the metal has been heated to a high cherry red and quenched in oil; the troostite particles appear as jet black and are easily colored by picric acid.

Trouble.—1. A circumstance or thing that occasions difficulty or perplexity.

2. In mechanics, toilsome exertion; labor; pains.

3. In mining, a slight fault: also known as check heave, slip, slide or throw.

Trough.—1. A shallow vessel, much longer than its width.

2. A shallow conduit, usually of V or U section, open at the top.

Trow.—1. A steelyard; a balance.

2. A wooden air shaft in a mine.

Trowel.—A flat bladed tool, usually triangular with a rounded point, furnished with a cranked handle. Used by masons in spreading mortar, cement and plaster, or by moulders in trimming their moulds. Made in a variety of shapes and sizes for different uses.

Troy Weight.—Used for weighing gold, silver and jewels:

TABLE.

24 grains (gr.)	make 1 pennyweight, dwt.	
20 pennyweights,	1 ounce,	oz.
12 ounces,	1 pound,	lb.

A carat, for gold weight, is 4 grains: for diamond weight, is 3.2 grains.

Truck.—1. A strong vehicle, especially one with four wheels, for transporting

machinery, freight, and other heavy articles.

2. A low vehicle, similar to a wheelbarrow, with, however, two small stout wheels, in place of one, and a forward lip, for use in moving barrels, boxes, etc., by hand; a *barrow-truck*.

3. A swiveling carriage having two, four or six wheels placed under a locomotive or car.

4. The disc or cap at a masthead.

Truck Center Plate.—In a locomotive, one of a pair of plates which supports a truck, being made to fit into each other. One of a pair is affixed to the cross tie or bolster on the tender or locomotive, the other is attached to the bolster of the truck. The center pin, or king pin, fastens the two together, but does not serve as a pivot.

Truck Jack.—A lifting jack, suspended from a truck axle to lift logs or other objects so that they may be loaded on to a sled or other low bodied vehicle. The *calipers* that embrace the log are hooked to the *catch* in the end of the ratchet bar. The bar is raised by the lever, and is dogged by its attendant *pawl*.

Truck Side Bearing.—In a locomotive, a support for a tender on the truck bolster, generally consisting of a pair of plates each side of the center line, one plate of each pair being on the bolster, and the other on the body bolster or cross-beam. When the tender tilts through an uneven track, the side bearings take the strain.

True Plane.—A surface plate so prepared that it is flat in every direction; used for testing surfaces.

True Water.—In hydraulics, mean depth of water at a given place.

Truing.—A term of wide application in workshop practice; including the operations of straightening bent shafting or the like, getting a grindstone into a correct outline, setting up a fly wheel or pulley, so that it runs evenly without sidewise motion at its rim, making an edge straight or bringing two parts square with each other, etc.

Truing Tool.—A device for turning the face of a grindstone, or any other surface for which it may be adapted.

Truncated.—Said of a tapering figure, which has had its apex or point removed. A truncated pyramid or cone is complete save for the apex, thus differing from the *frusta* of those figures, which represent their bases or butts only.

Trundle Wheel.—A type of gear wheel employed in clocks, etc. It resembles a cylindrical cage, the teeth being replaced by round bars thrust through the two discs which form the cheeks of the wheel, the *driving spur wheel* working between the two discs.

Trunk.—1. The main body or stock of a tree, a light framed box or case with a hinged cover; as, a traveler's *trunk*.

2. A conduit of rectangular section, built of planking or thin metal, to serve as a passage for air or other gases.

3. A similar long narrow box removing dust, fluff or broken material from various machines or operations.

4. A trough conveying water; a *flume* or *penstock*.

5. A miner's sluice in which slimes are concentrated and settled.

6. A tubular piston rod of large enough diameter to permit the lateral vibration of the connecting rod; as, in a *trunk engine*.

Trunk Engine.—A steam or gas engine, in which the connecting rod is coupled to crank and piston, reaching the latter through a large hollow "trunk" or rod, forming a part of the structure. The trunk engine was so named by its inventor, Humphrey, in 1835.

Trunk Piston.—A long cylindrical piston into which the crosshead of the connecting rod is secured, thus eliminating a piston rod. Such pistons are used in single acting steam and gas engines, their outer ends being much prolonged to serve as guide shoes.

Trunk Valve.—In steam engineering, a term applied to that form of D slide valve which is made sufficiently long to govern the entrance of the steam to ports placed near the ends of the cylinder.

Trunnion.—1. One of two cylindrical projections on the sides of anything, serving as supports for it, and also permitting it to rock, or be moved through a vertical angle. This method of suspension is applied to cannons, to oscillating engine cylinders, Bessemer converters and the like.

2. In steam engineering, one of the hollow axes on which the cylinder of an oscillating steam engine reciprocates, and through which steam is received and exhausted.

Trunnion Box.—A self aligning bearing for shafting, mounted on trunnions like a cannon, instead of being fitted with a ball and socket joint.

Trunnion Coil.—A heating coil which is mounted on trunnions or bosses within stuffing boxes, which permit it to be

partly revolved for inspection or clearing without taking down.

Truss.—1. In carpentry, a collection of timbers and irons forming one of the principal supports; as, of a roof or bridge, framed together so as to give mutual support.

2. In architecture, a framed structure, with diagonal as well as vertical bracing; the vertical loads are transmitted by the diagonals, which are thus put in a condition of *tensile stress* instead of compressive.

3. In navigation, the iron hoop, stirrup or clasp, by which the middle of a lower yard is secured to the mast.

Trussed Beam.—In mechanics, a long beam whose power of resistance to bending strains is increased by transmitting those strains through a truss rod.

Trussed Ladder.—A ladder provided with stayrods which form a truss to stiffen it.

Trussed Roof.—One involving the principles of a truss; containing (a) principals, (b) purlins, (c) struts, and (d) ties.

Trussed Shaft.—In machinery, a long light shaft rendered rigid by truss rods arranged around it. Trussing is applied to shafts whose length is such as to require some intermediate support, which support it is not convenient to give otherwise than by trussing.

Truss Hoop.—A hoop or band placed by coopers around the chines of casks, drawing the staves together at that point and leaving the middle portion bulging.

Trussing Machine.—In cooperage, one for drawing the truss hoops upon casks, to bring the ends of the staves together at the chines. A *hoop driving machine*.

Trust.—1. An organization formed mainly for the purpose of regulating the supply and price of commodities, etc.; as, a sugar trust.

2. Credit given; especially delivery of property or merchandise, in reliance upon future payment.

3. Assured resting of the mind on the integrity, veracity, or other sound principles of another person; confidence; reliance.

Trustee.—A person to whom property is legally committed in trust, to be applied either for the benefit of specified individuals, or for public uses; one who is intrusted with property for the benefit of another; also, a person in whose hands the effects of another are attached in a trustee process.

Trustworthy.—Worthy of trust or confidence.

Truth.—A shop term to denote the accuracy of work. The getting of a straight edge or grindstone or square into correct outline is termed *truing up*. A shaft or spindle is true when it is straight or in line and of equal or correct diameter. A piece of stuff is true when of equal thickness, or when not winding; a cylindrical piece of work is true when it fits to gauge or calipers. Tools used for measurement are employed to check the *truth* of work.

Try Cock.—In steam and hydraulic engineering, a faucet or rotary valve, taking its name from its peculiar use; hence, a try cock is for *trying*; as, in a pump.

Trying Plane.—A joiner's plane used to secure the greatest accuracy of surface possible by hand. Its length is 22 ins. with a $2\frac{1}{4}$ inch iron. Also known as a *jointer plane*.

Trysail.—A fore and aft sail, in form of a trapezoid carried on a gaff at the after side of a mast.

Try Square.—The square commonly employed by mechanics to test the accuracy of work; it has a thick stock and a thin blade, so that it may stand alone. Woodworkers use a try square with a wooden stock.

T Slots.—In machinist's work, slots or grooves cast in the tables of planing, shaping, slotting and drilling machines for carrying the heads of *T headed* bolts. T slots should preferably be planed on their inner edges.

T Square.—A rule having a crosspiece or head, on one end, used for making parallel lines, so called from its shape. Sometimes the head is made to be set at different angles by means of a *swivel*.

T. U.—Abbreviation for thermal or heat unit. B. T. U., British thermal unit, expresses the same thing.

Tub.—1. A broad open topped vessel, usually of wood and formed with staves, bottom, hoops, and handles on the sides.

2. A small cask.

3. In mining, (a) a small car in which coals are conveyed from the working face to the bottom of the shaft, and thence to the surface; also known as *corve*, *tram*, etc.; (b) a *keeve* or *concentrator*.

4. In metallurgy, a form of chamber, in which ore or slimes are washed to remove lighter refuse.

5. The amount that a packing tub contains; as, a tub of grease.

Tubate.—Tubular; of the form of, or provided with a tube.

Tube.—1. In a steam boiler, a small pipe either containing water, or surrounded by water, which is heated, in either case, by the products of combustion passing over the other side.

2. A pipe or hollow cylinder for conveying fluids.

Tube Cleaner.—In steam engineering, a stiff brush or metallic scraper screwed to the end of a rod and used for removing the soot from the tubes of a boiler.

Tube Drawing.—1. In steam engineering, the periodical taking out of the tubes of multitubular boilers, for the purpose of thorough examination.

2. The manufacture of tubes in various materials, by drawing them through a draw plate, with or without the aid of a triblet. The tubes thus made are either drawn through a welding heat and so united, or they are welded or brazed first, and then drawn to impart the necessary finish to their exterior and interior surfaces, or they are solid drawn, that is, cast and drawn, or drawn from a semi-fluid mass only.

Tube Expander.—A tool for expanding boiler tubes within the tube plate, causing them to hold more firmly. A center piece is fitted with cylindrical rollers, and inserted within the tube end. A long taper pin is placed between the rollers and rotated; as it revolves, it turns the rollers around and forces the material of the tube into a tiny ridge each side of the plate, thus gripping it and preventing leaks.

Tube Ferrules.—In steam engineering, rings of hard wood, used for holding condenser tubes to their plates. The ferrule fits between the outside of the tube and the hole in the plate, and being swelled by the action of the water, renders the tubes water-tight.

Tube Ignition.—An early form of igniting device for gas engines; also sometimes applied to oil engines. A closed tube of platinum, porcelain, or latterly nickel alloy is exposed to the heat of a Bunsen flame, which makes it red hot. A passage communicates from the clearance space of the cylinder to the interior of the tube; this passage is closed by the timing valve, which opens when the charge is compressed, thus firing the latter.

Tube Mill.—A disintegrating apparatus for pulverizing ores or other materials, consisting of a revolving horizontal cylinder, slightly inclined, in which is placed a number of flint or steel balls.

The pounding and rubbing action of the hail of balls quickly reduces materials to powder, which passes out through screens at the lower end.

Tube Packing.—A bag of flaxseed, or ring of rubber to occupy the space between the tube of an oil well and the bored hole, to prevent access of water to the oil bearing stratum.

Tube Plate.—One of the plates within a boiler, condenser, etc., which is drilled with holes for the reception and support of the tubes. Each plate is defined according to its position; as, *fire box tube plate*, *middle condenser tube plate*, etc.

Tube Plate Cutters.—Trepanning tools, having a spindle guided by a central hole, while a cranked tool cuts out a disc, corresponding to the hole required for the reception of a boiler tube.

Tube Plate Stay.—An iron rod passing across the boiler and having heads or nuts on the outsides of the respective sheets, to tie the plates together and prevent their disruption by the pressure of steam.

Tube Plug.—A tube stopper, to be used in case of the leak of a boiler tube, usually consisting of a double wooden plug with a smaller central part. The plug is forced into the tube until the small part is opposite the leak; the plug is then in equilibrium and will not blow out, while the wood rapidly expands and fills the tube. This device is rarely used, a special stopper being more frequently applied in cases of emergency, or the tubes cut off altogether, when conditions permit, by means of a disc on either tube plate, held together by a through stay.

Tube Rolls.—In a paper making machine, a number of small rolls supporting the endless wire cloth, in its horizontal passage.

Tubes.—In a steam boiler, the pipes or tubes employed for conducting the products of combustion from the fire box to the chimney, taking heat from them during their passage and transferring it to the water in the boiler. The tubes are fitted into holes in the tube plates at either end of the boiler, being expanded or beaded therein, or occasionally fastened with a copper or iron ferrule. Formerly tubes were made of brass or some copper alloy, but charcoal iron and mild steel are generally used at the present time.

Tube Scaler.—In steam engineering, a tool for removing scale and other incrustation, from the inside of steam boilers.

Tube Scraper.—An instrument or appliance for removing soot and ashes from the interior of boiler tubes.

Tube Sheets.—The round, flat flanged sheets forming the two ends of a steam boiler, into which the tubes are fastened.

Tube Stopper.—A special plugging arrangement for shutting off boiler tubes that have developed leaks.

Tube Surface.—In steam engineering, the total area of the exterior surface of the tubes in a surface condenser. The extent of this area is variable in different engines, being dependent on the efficiency of the cold water circulation, but it may be taken for marine engines at from 1.5 to 3 square feet per I. H. P. for terminal pressures ranging from 6 to 30 lbs. absolute.

Tube Well.—A small artesian well for obtaining water from shallow strata, consisting of a pointed pipe driven into the ground without boring. The point is generally shod and is perforated for a foot or two above the cone; for fine materials, the perforations are protected with wire gauze covered by perforated brass. The tube is driven by blows of a ring weight or clamps bolted around the pipe, the clamps being shifted as fresh lengths are screwed on. The tubes vary from one and one half inches to four inches diameter, the well being from twenty to thirty feet deep, rarely fifty. The *air lift* is much used in connection with these tube wells.

Tabing.—1. Pipes or tubes, generally considered.

2. The casing or lining of a well, or, more generally, the rising main within the same, composed of lengths of tube fastened together.

Tub Sizing.—In paper making, passing high class goods, such as writing papers, through a bath of gelatine or glue, after calendering, either in individual sheets or as a continuous web. Also known as *surface sizing*.

Tubular.—1. Shaped like a tube; as, *tubular* compasses which have hollow legs, within which slide lengthening bars or tubes.

2. Provided with tubes; as, a *tubular* boiler (marine, locomotive, portable, vertical or sectional) in which the hot gases circulate within the tubes, which are provided to increase the heating surface.

Tubular Arch Bridge.—A bridge supported by a tubular archway of iron or steel.

Tubular Boiler.—A boiler having tubes through which the products of combustion

tion pass, imparting their heat to the water; as, in a *locomotive* or a *marine* boiler.

Tubular Floating Dock.—One whose buoyancy depends upon air-tight chambers or cylinders. These are wooden cases, or iron caissons.

Tubular Radiator.—A radiator for a motor vehicle, consisting of a series of coiled tubes, usually provided with fins or gills. The jacketwater circulates inside the tubes.

Tubular Saw.—A cylindrical saw with teeth around its base, after the manner of a *crown cutter*. It is employed for sawing wood to a curvature corresponding to that of the saw.

Tubulous Boiler.—A boiler constructed of tubes containing the water, around which pass the flames and furnace gases. A *water tube boiler*.

Tub Wheel.—In hydraulics, a form of water wheel which has a vertical axis and radial spiral floats, which are placed between two conical cases attached to the axis. The water is precipitated from a chute upon the wheel, and follows the spiral canals of the wheel until it is discharged at the bottom. It is a combination of the horizontal and common recoil wheel; the water, having exerted a certain percussive force, flows downward, and passes out like that in the *downward discharge turbine*.

Tue Irons.—Tongs used by blacksmiths.

Tufa.—A calcareous deposit which affords a hydraulic lime. *Trass*, *terras*, *pozzuolana* are local names, and vary in quality to some extent.

Tuft.—A collection of small, flexible or soft things in a knot or bunch; a spreading cluster.

Tug.—1. A steam vessel having powerful engines and specially adapted for towing other vessels; also, called *steam tug* and *tug boat*.

2. To pull with a great effort; straining pull.

3. A part of a harness; as, a *trace*.

4. In mining, an iron hoop to which a tackle is attached.

Tumbler Bearing.—A support for long revolving shafts; as, in a shafting lathe or a traveling gantry. The bevel wheel or worm, sliding in a keyway on the shaft, is carried along by the lathe carriage or by the gantry, and serves to communicate the motion of the shaft to the gearing on the traveling part. The bearings are pivoted on the side of the

lathe bed or of the girder, and are counterweighted at the lower end of the supporting arms. As the carriage or traveler comes into contact with a bearing, the latter is depressed, permitting the former to pass, but returns immediately to its position when released.

Tumbler File.—A double, half round file, formerly employed in finishing the tumblers of gun locks, whence its name. The files are *taper* and *double cut*.

Tumbler Lock.—A common lock, as used for doors, etc., in which a tumbler or latch engages with notches in the bolt of the lock, preventing its motion until the tumbler has been lifted or displaced by the key, which removes the obstacle and then shifts the bolt.

Tumbling Barrel.—A contrivance, wherein a barrel having a rotary motion is loosely packed with small castings, so as to clean them by friction with each other and numerous pieces of slag. The same device is used for polishing, and is the means whereby small cast iron balls are ground and polished into the spherical shape for ball bearings. Known also as *rattler*, from the noise it makes when turning with its contents.

Tumbling Bay.—In hydraulic engineering, an overflow dam or *weir*, especially one with a notched board, etc., for measuring the flow.

Tumbling Shaft.—In machinery, a cam shaft, employed in stamping mills, threshing machines, etc.

Tun.—1. The fermenting vat of a brewery.

2. A large cask for holding liquids.

3. A measure of capacity, equal, by old statutes, to 252 wine gallons.

Tundish.—A conical vessel by means of which liquids are poured through a small orifice; a *funnel*.

Tungsten.—Also known as *Wolfram*. A metallic element difficult to reduce from its ores; resisting most acids, unalterable in ordinary air, and extremely difficult to fuse. It is alloyed with steel to form *Mushet*, and other self hardening high speed tool steels.

Tungsten Steel.—There are two varieties of steel with which tungsten is alloyed:

1. In alloys from $\frac{1}{4}$ to 5 per cent.; it has been used for axes, tires, tools, dies, etc., the percentages increasing in the order given. Chisels of $\frac{1}{4}$ per cent. tungsten steel are *hardened* at a cherry red in a mixture of rosin, tar and tallow, and then *tempered* to a blue, quenching in water at 60° F.

2. Self-hardening steel or *Mushet* steel, contains 8 to 9 per cent. tungsten and about $\frac{1}{4}$ per cent. manganese. This is hard enough to turn

rolls in its untempered state, or scratch glass, but cannot be hardened by ordinary processes. It must be shaped by forging and grinding, and hardens as it cools.

Tuning Hammer.—A hammer shaped wrench used for tuning a stringed instrument, as a piano.

Tunnel.—1. A flue for the passage of smoke; a passage for conducting railroads under elevated grounds.

2. In a steamer, the passage or alleyway around the line of intermediate shafting, giving access to the various bearings, and especially the stern gland.

3. In mining, the same as *adit*.

4. A bore or passage through a hill.

Tunnel Borer.—In civil engineering, a ram, operated by compressed air, for making excavations through rock. It is said that the battering ram was used by the ancient Romans in making tunnels, where their aqueducts had to pass through rocky strata.

Tunnel Head.—A chimney surmounting the charging holes of open topped blast furnaces, to carry the flame clear of the charging holes.

Tunnel Shafting.—On a steamship, the intermediate shafting in the tunnel or screw alley.

Tup.—A heavy weight, used as a hammer. So called because *tup* is another name for a *ram*, a heavy mass acting by impact being known as a *ram*, on account of the butting propensities of the animal.

Turbid.—1. Having the lees or sediment disturbed; muddy; thick; not clear; used of liquids of any kind.

2. Disturbed; confused; disordered.

Turbine.—A machine in which a rotary motion is obtained by transference of the momentum of a fluid; broadly speaking, the fluid is guided by fixed blades, attached with a casing, and, impinging on other blades mounted on a drum or shaft, causing the latter to revolve.

Turbine Check.—A form of check valve having its wings curved out like the blades of a turbine, so that it revolves on its seat every time it lifts.

Turbine Pump.—A multiple centrifugal pump, with several impellers in series, suitable for pumping against high heads. More generally known as *series* or *multi-stage centrifugal pump*.

Turbine Wheel.—The rotor or rotary part of a turbine, as distinguished from the casing, shrouding or *stator*.

Turmeric Paper.—A test paper, second in value to litmus paper alone. Turmeric root is digested for some days in strong alcohol in a warm place. Blotting paper soaked in the solution assumes a deep orange yellow color, the paper being dried and cut into slips. Acids, with the exception of boric, do not change the color, but alkalies turn the slips a deep chocolate brown. Another use is in testing for boric acid; if a solution turns blue litmus paper red, and yellow turmeric paper brown, the presence of boric acid is certain.

Turmoil.—Trouble; molestation by tumult; disturbance; worrying confusion.

Turn Bridge.—A swivel or swing bridge.

Turnbuckle.—A loop or eye of metal with a nut at either end, one being screwed with a left hand thread, the other right handed. Used to tighten stayrods or similar tension members in many structures.

Turned Bolts.—In machinery, these are used on all good machine and engine work, their holes being drilled or bored to make a good fit. The employment of turned bolts is necessary to prevent the displacement of parts due to vibration.

Turner.—A skilled workman who operates a lathe.

Turnery.—1. A department or shop in which turning is carried on.

2. Wooden articles formed in a lathe; such as handles for many implements, domestic utensils, etc.

Turning.—The art or process of bringing work to a circular form in a lathe. That branch which forms external cylindrical surfaces constitutes turning proper; the production of internal circular surfaces is known as *boring*; the formation of screw threads, by the intervention of a definite ratio of revolution to the travel of the automatic tool rest, is termed *screw cutting*.

Turning Carrier.—A device for holding metallic work while being turned in the foot lathe. The work is clasped by the carriers, which are caused to rotate by means of the drivers fixed to the lathe mandrel.

Turning Chisel.—In turning, an obliquely ground, double beveled chisel used for turning smoothly, or finishing the surfaces of woodwork in the lathe. It is

not held flat, but at an angle with the axis of the stuff. Much pattern work, being of large diameter, necessitates the employment of the scraping or ordinary firmer chisel; hence, that is also frequently, though incorrectly, termed a turning chisel.

Turning Engine.—In navigation, a small auxiliary engine of one or two steam cylinders with reversing mechanism, used for driving the turning gear in all but small vessels.

Turning Gauge.—An instrument to assist in setting over the tailstock of the lathe, so that a given taper in a certain length of work may be obtained.

Turning Gear.—A hand or power driven mechanism of gearing connected at pleasure with a large worm wheel mounted on the crank shaft, used to rotate the engines for overhauling purposes, etc.

Turnings.—In metals, turnings, borings, and other metallic shavings cut off by processes of drilling, planing, shaping, slotting, etc., are, when of *cast iron*, utilized in the making of iron cement; when of *wrought iron* and *steel*, fagoted or remelted; when of *brass* and *gun metal*, remelted.

Turning Saw.—A frame saw used by wood turners. The blade differs from that of the jig saw, in that it is parallel whereas the other has a beveled back to clear the work.

Turning Tools.—The cutting implements used by turners; these vary considerably according to the nature of the material to be operated on and the character of the work.

Turn Out.—In a railway, the simplest kind of switch, where one line curves from a straight line or another curve.

Turnover Board.—In a foundry, a board used for ramming a pattern upon; first, when the pattern is so flimsy that it would otherwise become rammed out of true, or secondly, when the quantity of castings required is so large that the use of a board will save the time the moulder would otherwise occupy in making sand joints. Also called *bottom board* and *joint board*.

Turnpike.—1. A toll gate across a road.
2. A proprietary road, where toll is collected. The name has come to signify one which is graded and either macadamized or graveled.

Turn Pin.—A taper pin or cone of box-wood employed by plumbers to enlarge or flare the ends of lead pipes, preparatory to making a joint.

Turn Spout.—A discharging spout for grain elevators, etc., mounted on a swiveling socket or support so that it may be slued to any desired angle.

Turnstile.—A post with four horizontal arms, which revolve as a person pushes by them.

Turntable.—In railway engineering, a platform which rotates in a horizontal plane, and is used for shifting rolling stock from one line of rails to another. Devices common to all are the platform, which has one or more tracks of rails on its upper surface, rollers on which it turns, gearing for rotating it, a central pivot on which it rotates, a circular track on which the rollers move, and solid foundations for the track and for the central pivot.

Turpentine.—A vegetable oil obtained from various trees, principally akin to the pitch pine. Incisions are made in the trunk, or portions of the bark lifted, the flowing oil being collected in suitable vessels. The turpentine is subjected to distillation, resulting in the *spirits of turpentine* used by painters, and a solid residue termed *rosin*.

Turpentine Hack.—A tool for barking and cutting pine trees, to allow the crude turpentine to run.

Turrel.—1. In cooperage, a cooper's tool.
2. In carpentry, a little wooden instrument to fasten doors or windows.

Turret.—1. In a lathe, a cylinder arranged to turn on an upright axis, and sliding on the ways, fitted with sockets or chucks for the reception of various tools, any one of which may be presented as needed in the axial line of the work; as, for boring, tapping, etc. Called also *turret head*.

2. In architecture, a small tower usually placed at the angles of a building for purposes of defense, observation, or ornament.

Turret Drill.—A drill press having numerous drills mounted in a *turret head*.

Turret Head.—A device, similar to the turret rest of a lathe, containing a number of drills, cutting tools, etc., which may be brought into successive use on the work. The turret head is usually an adjunct applied to a plain lathe or drill press, being mounted on the tailstock or spindle.

Turret Lathe.—A lathe having a turret tool rest; a *capstan lathe*.

Turtle Back.—In navigation, a certain class of ships with large overhanging decks.

Tusk.—1. In locksmithing, a sharp projecting point or claw which forms a means of engagement or attachment. Used in the parts of locks in which bolts, tumblers, etc., are thus provided, so as to be touched, dropped, raised, etc., by the key, directly or by intermediate devices.

2. In carpentry, the beveled shoulder on the back of a tenon of a binding joist, to strengthen it.

Tutty.—In mechanics, an impure oxide of zinc, used as a polishing powder; it is obtained, as a sublimate, in the flues of zinc smelting furnaces.

Tuyere.—In metallurgy, a tube having a conical end, with its appurtenances for regulating and directing a current of air upon the metal in a smelting furnace or forge. Also called *tuyser*.

Tuyere Arch.—1. In a blast furnace, the arch through the mantle or outer casing, giving access to the *tuyeres*.

2. An opening into the crucible of the furnace, in which the tuyere is placed. The space between the tuyere and the arch is termed the *breast*, and is tamped with clay.

Tuyere Arch Cooler.—A hollow frame of cast iron, through which water is circulated, surrounding the breast in which the tuyere is placed. Also termed *water breast*.

Twelfth.—Next to the eleventh; coming after the ordinal of ten.

Twelve.—One more than ten; twice six; a dozen.

Twelve Wheel Lock.—A class of machine road, a class of machine having eight or four wheel leading.

Twentieth.—The twentieth; coming after the nineteenth; tenting after nineteen.

Twenty.—The twentieth; the sum of two tens; twenty score.

Twenty-fourmo.—Leaves to a sheet of paper in book form, book, leaf, composed of sheets, composed of twenty-four into twenty-four, ing more or less whose sheets are written 24mo.

Twibil.—1. A machine; the blade like the other like an. 2. A mortising. 3. A reaping machine.

Twill.—1. An appearance or ribs produced in the weft threads under two, or over two or more, warp threads.

twisted together: as, binder *twine*; any coarse strand or small cord; a string of several strands; especially, if of hemp or manila.

2. A strong hempen thread used in sewing sails.

Twine Machine.—A spinning machine for small hempen or cotton string. A *thread machine*.

Twin Screw.—In navigation, when a vessel is fitted with two independent engines driving separate propellers, she is said to be fitted with twin screws.

Twirl.—1. To revolve with velocity; to be whirled around rapidly.

2. The act of twirling; a rapid circular motion; a whirl or whirling; quick rotation.

Twist.—1. Specifically, that which is formed by twisting, or uniting the parts; as, (a) a cord, thread, or anything flexible, formed by winding strands, or separate things round each other; (b) a kind of closely twisted, strong sewing silk, used by tailors, saddlers, and the like; (c) a kind of cotton yarn, of several varieties; (d) in weaving, a warp of a certain reed which can be joined to another by twisting.

2. To wreath: to wind; to encircle; to unite by intertexture of parts; to unite by winding one thread, strand, or other flexible substance round another; to form by winding separate things round each other; as, to twist yarn or thread.

Twist Bit.—A boring tool for *wood*, with a cutting part like the *twist drill* used for metals.

Twist Drill.—A drill grooved longitudinally and spirally, for the purpose of clearing itself from the waste material, the borings passing up the grooves as the drill is fed into the work.

Twist Drill Grinder.—In tools, since so much of the efficiency and satisfactory working of twist drills depends on the angle of their cutting lips being maintained intact, grinding machines have been devised, by which this constant angle is maintained, the drill being held in a socket or clip, against a rapidly revolving emery wheel.

Twisted Belt.—In millwrighting, driving belts are sometimes twisted to secure their better adhesion, and so save the trouble of tightening up. But, as commonly understood, twisting refers to the turning of a belt through a definite angle, to drive pulleys whose axes are not

on the same plane, or to drive machines in opposite directions.

Twisting Machine.—A machine for twisting and laying rope and cordage.

Twisting Mill.—Also termed thread frame. A machine resembling in many respects, the throstle, and used for forming sewing thread.

Twisting Strain.—In mechanics, a torsional or winding strain; a strain which will wrench or twist out of shape.

Twitter Bit.—The bottom of the countersink which receives the head of the screw; as, the one uniting the halves of a pair of scissors.

Two.—One and one; the sum of one and one; the number next less than three.

Two Cycle.—A type of internal combustion engine in which the four operations of charging, compression, explosion and expulsion are carried out during two strokes of the one piston. The piston usually serves as exhaust valve; the exploded charge escaping through ports in the cylinder wall, which are uncovered by the piston as it nears the extremity of its outward or power stroke. The incoming charge is either admitted by a separate valve or pump, or else passes into the cylinder by ports opposite the exhaust port, the charge being deflected to the end of the cylinder by a ridge upon the piston, and *scavenging out* the products of combustion as it comes in. Compression ensues upon the closing of inlet and exhaust ports by the piston.

Two Edged.—Having two edges, or edges on both sides.

Twofold.—1. Double; duplicate; two-ply; consisting of two thicknesses; as, belting, etc.

2. Woven double; as, cloth or carpeting by incorporating two sets of threads of the warp, and two threads of the woof.

Two Handed Saw.—A whip saw used in getting out ship timbers. It has a handle at each end, one for each man.

Two High.—Said of a *roll train* of a furnace having two sets of horizontal rolls, one placed over the other.

Two High Rolls.—In rolling mills, two rolls only, one above the other, for rolling bar iron, or plates. In such rolls the bar must, when passed through, be either drawn back over the top, so losing a *pass*, or the mill must be reversed.

Two Jawed Chuck.—A self centering chuck, usually employed to hold a twist drill or the like.

Two Speed Pulley.—A variable speed arrangement consisting of two fast pulleys, the shaft of one being tubular and sleeved upon that of the other. One connects by large and small wheels to the lower shaft, and the other by large and small wheels, the difference in communicated speed being very apparent, and the belt being shifted from the loose pulley to one or the other of the fast pulleys, as may be required.

Two to One Gear.—In four cycle gas engines, the system of bevel or spur gearing driving the half speed shaft, which revolves once to every two revolutions of the crank shaft.

Two Way Cock.—In hydraulics, by the two way cock, the water may be distributed to each of two branches separately, or be entirely shut off.

Two Wheeled Barrows.—Barrows having two wheels, one on each side of the front of the barrow, instead of the ordinary central one, are much used in foundries for wheeling the castings and moulding boxes about, because the risk of their overturning is minimized thereby. Used also in machine and erecting shops and yards for a similar purpose, as also in construction work for moving mixed concrete and other materials.

Tye.—1. In navigation, a rope by which a yard is hoisted. It passes through the mast; one end is attached to the middle of the yard, and the other end is hooked to a purchase composed of the *tye block* and fly block, by which the hoisting is effected.

2. In mining, an inclined trough for separating ore by means of a flowing stream of water. The slimes are allowed to flow in a thin wide stream upon the upper part of the trough, are disturbed by a broom, and collected, according to relative weight and quality, at different parts of the length of the trough. The sorts are known as *heads*, *middles* and *tails*, the first going to pile, the second is *retyed* and the third is refuse.

Tying.—In building, the lashing together of spars, etc., forming a scaffold, with scaffold cords, galvanized wire, etc.

Tymp.—The fire hearth of a blast furnace, adjoining the crucible. Its outer boundary is the *dam*, preventing the molten metal from running save on to the sand-bed, when tapping.

Tympan.—In printing, a frame covered with parchment or cloth, on which blank sheets are put in order to be laid on the form to be impressed.

Tympanum.—1. In architecture, the recessed face of a pediment within the

frame made by the upper and lower cornices, being usually a triangular space or table.

2. In stone work, the space within an arch and above a lintel or a subordinate arch, spanning the opening below the arch.

3. In hydraulics, a drum shaped wheel with spirally curved partitions, by which water is raised to the axis, when the wheel revolves with the lower part of the circumference submerged.

Tymp Plate.—A plate in front of the hearth of a blast furnace, sustained and protected by the *tymp stone* which is immediately exposed to the heat. The tym plate is imbedded at its ends in the side of the hearth, and itself sustains the front.

Type.—1. A raised letter, figure, accent, or other character, cast in metal or cut in wood, used in printing.

2. Types in general; the whole quantity of types used in printing, spoken of collectively. Types are mostly made by casting type metal in a mould, though some of the larger sizes are made from maple, mahogany or boxwood.

3. Form; kind; sort; the mark or impression of something.

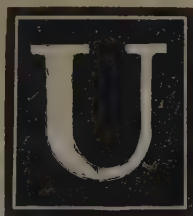
Type Founding.—The art or process of casting metallic type for printing. Large type, such as are used for posters and the like, are carved from wooden blocks and not cast. A place for casting type is called a *type foundry*.

Type Metal.—A metallic compound, used for making types; especially a compound of lead and antimony in the proportion of three to one, with a small proportion of tin, and sometimes a little copper.

Typewriter.—A machine which by pressing upon a key in a keyboard causes a corresponding type to make an impression upon a sheet of paper, the ink being supplied by a traveling ribbon. The apparatus is so designed, that the paper moves on automatically as each letter is struck, the spacing of words being effected by a separate key. Various devices are incorporated to control the indentation and alignment of the different lines.

Typhoon.—A violent hurricane occurring in the China seas and their environs, principally during the months of July to October. Typhoons are prolonged cyclonic storms of great intensity, and correspond in every respect to the West Indian hurricanes which occur in the same latitudes in the Western Hemisphere.

Typography.—The art of printing from movable type; the act, process or art of composing and printing from type; especially *type setting*.



U.—A letter ; the twenty-first in the English alphabet.

Udometer.—An instrument to determine the quantity of rainfall. A rain gauge. An ombrometer or pluviometer.

Ult.—Abbreviation of *ultimo*; last; as, 15th ult., meaning the 15th of last month.

Ultimate.—1. Furthest ; most remote in space or time ; extreme ; last ; final.

2. Incapable of further analysis ; incapable of further division or separation ; constituent ; elemental ; as, an ultimate particle ; an ultimate constituent of matter.

Ultimate Set.—In materials, the difference between the length of a specimen plate or bar before testing, and at the moment of fracture ; and given in percentage of the length. This amount, in conjunction with the reduction of area, is a measure of the ductility of the plate or bar, since it is measured after fracture, by laying the broken ends together. It is also termed the *set after fracture*.

Ultra.—Going beyond others or beyond due limits ; extreme ; uncompromising.

Ultramarine.—A blue color, originally prepared from *lapis lazuli*, but now usually produced by chemical means. The credit of first artificially producing this beautiful pigment, at a price enabling it to be extensively employed in the arts, appears to be due to *Grimet*.

Ultra Vires.—Beyond power ; transcending authority ; a phrase, used frequently in relation to acts or enactments by corporations, in excess of their chartered or statutory rights.

Umber.—An earthy form of a brown hydrated oxide of iron, originally found in Umbria, in Italy, and used as a pigment, to secure deep rich effects. The color, darker and browner than those of the ochres, is due to the presence of manganese oxide. The natural earth or raw umber, is heated in a furnace almost to a red heat, the resultant burnt umber being a red oxide of iron, and giving a darker color than the raw.

Umbrella.—A light frame covered with fabric, and held above the head as a pro-

tection against sun or rain. The name in the Latin, is from the word *umbra* "shade" and means "a little shade," and is similar to the Roman word, *umbra-culum*.

Umpire.—A person to whose sole decision a controversy or question between parties is referred ; especially, one chosen to see that the rules of an association, as of a union, are strictly observed.

Unanimous.—Being of one mind ; agreeing in opinion, design, or determination ; harmonious ; as, the vote is unanimous.

Unbar.—To remove a bar or bars from ; to unbolt ; to open ; as, to unbar a gate.

Unbolt.—To remove a bolt from ; to unfasten ; to unbar ; to open ; as, to unbolt a freight car.

Undercut.—In coal mining, to hew a narrow opening into the lower part of the seam, afterwards breaking down the coal by wedges, shot firing, etc.

Underfeed Stoker.—In steam engineering, a mechanical stoker, in which the power furnished by a piston or ram forces broken coal up through the fire bars into the fuel bed. This prevents the evolution of smoke.

Under Frame.—1. The main frame of the chassis of an automobile.

2. The frame of a railway vehicle, upon which the body is erected.

Underground Railway.—One wholly or in large part beneath the street surface of a city.

Underhew.—In millwrighting, to hew less than is usual or proper ; specifically, to hew ; as, a piece of timber which should be square, in such a manner that it appears to contain a greater number of cubic feet than it really does contain.

Underhung Springs.—In a locomotive, bearing springs suspended under the axle box.

Underlayer.—In mining, a perpendicular shaft, sunk to cut the lode at any required depth.

Under Pinning.—The art or operation of supporting the walls of buildings while excavations are being made beneath, or repairs executed upon their footings. A beam or *needle* is placed through an opening in the lower part of the wall, at right angles to it, the ends of the needle are supported by means of pillars or squared balks at either end, the whole wedged up, thus relieving the footings of all weight.

Under Reamer.—In well boring, a tool having two legs or cutters, spread open by a spring, used to ream or enlarge the borehole underneath the casing, permitting the latter to be lowered as the hole descends. Contact with the sides of the tube compresses the spring, and thus permits the under reamer to be drawn through the casing.

Underrun.—To run or pass under; especially, to pass along and under a cable, for the purpose of taking it in, or of examining it.

Under Runner.—A grinding mill, in which the lower of the two stones revolves, the upper remaining stationary. This form is especially useful in grinding up oats, corn, chalk, clay, etc., the material resting on the revolving stone, and being moved out from the center by centrifugal force.

Undersetter.—In erecting, an under pinning, prop or support.

Undersetting.—The operation of supporting earth in a cutting when situated beneath rock. A retaining wall is built against the face of the earth bank; *under pinning*.

Undershot Water Wheel.—One in which the water flows under the wheel, utilizing the velocity of the current rather than its weight. They are very wasteful, not having a better efficiency than 25 to 45 per cent. of the maximum. The wheel is set usually in a curb with as little clearance as possible. The buckets are usually about $\frac{1}{4}$ full, while the shrouding is 15" to 18" deep, to keep the water from entering within the wheel and retarding it.

Understanding.—1. The act of one who understands a thing, in any sense of the word; knowledge; comprehension.

2. An agreement of opinion; adjustment of differences; anything mutually understood or agreed upon; as, to come to an *understanding* with another.

Undertype Engine.—A class of compact steam engine, somewhat resembling a locomotive, the engines being placed under the boiler, which is of the locomotive type. The cylinders are usually compound, with an automatic expansion governor. The whole constitutes a compact power plant, costing little for foundations, and economical from the fuel standpoint. Much employed for small electric installations.

Underwriter.—One who engages in the business of insuring against loss, more especially in marine insurance. The term arose from the custom of dividing a policy of insurance, or agreement to reimburse specified losses, between several insurers, who wrote their names under the body of the policy, thus dividing the risk between several persons.

Underwriter's Pump.—A fire pump, of a pattern approved by Insurance Underwriters or by the Insurance Corporation's Surveyor, such as is fitted in large buildings in connection with the fire fighting apparatus, to maintain the water supply for hose, hydrants, sprinkler tanks, etc.

Undivided.—1. Not divided; not separated; unbroken; whole; continuous; as, plains undivided by rivers and mountains.

2. Not set off; as, a share in a firm; not made actually separate by division; as, a partner, owning one half in a firm, is said to own an *undivided* half, so long as the business continues and his share is not set off to him.

Undulation.—A movement corresponding to that of the waves of the sea. A periodic disturbance which is passed on continuously from one part of a medium to the next.

Unequal.—1. Not equal; not matched; not of the same size, length, breadth, quantity, strength, acquisitions, age, station, or the like; as, peers and commoners are unequal in rank.

2. Not uniform; not equable; irregular; uneven; as, unequal pulsations.

3. Not adequate or sufficient; inferior; as, the man was unequal to the emergency; the timber was unequal to the sudden strain.

4. Not having the two sides or the parts symmetrical.

Uneven.—1. Not level; not uniform; rough; as, uneven ground.

2. Not equal; not of an equal length.

3. Not divisible by two without a remainder; odd; said of numbers; as, 3, 5, 7, 9 and 11 are *uneven numbers*.

Unfold.—1. To open the folds of; to expand; to spread out; as, to unfold a sail.

2. To open; as anything covered or closed; to lay open to view; to bring out in all the details, or by successive development; to display; to disclose.

Unguent.—Anything which may be smeared on or rubbed in; a soft compound, such as is used for a lubricant.

Unhairing.—In leather manufacture, the process of removing hair from hides. This is performed by the action of lime, which dissolves the hair sheath and combines with the fat of the hide to form an insoluble soap. The lime is suspended in water in pits, and the hides placed therein, being occasionally handled; that is, taken out, drained and replaced in the pit, examination determining when the process is complete. The hides are then removed, laid over a beam, and the hair and epidermis removed by the *unhairing knife*.

Unhairing Knife.—In tanning, a curved, two handled iron scraper, for removing the hair from hides which are taken out of the lime pit and laid over the beam for that purpose. The beam is *semi-cylindrical* and the knife is *concave*, to fit the curvature.

Unhairing Machine.—In a tannery, one for removing hair, and sometimes flesh, from hides.

Uniformity.—Similitude between the parts of a whole; as, the uniformity of sides in a regular figure; sameness.

Uniform Load.—In mechanics, a load which is not a variable one and which, therefore, does not induce so great stress as the latter.

Uniform Motion.—The motion of a body when it passes over equal spaces in equal times.

Uniform Pitch.—In mechanics, a screw is said to be of uniform pitch when there is an equal distance between the helices, or blades, as distinguished from *increasing pitch*.

Union.—1. The act of uniting or joining two or more things into one; the state of being united or joined; junction; combination.

2. That which is united, or made one; something formed by a coalition of parts or members; a confederation; a consolidated body; a league; as, the weavers have formed a *union*, or so called *trade union*; the United States is often called the *Union*.

3. A textile fabric composed of two or more materials; as, cotton, silk, wool, etc., woven together.

4. A coupling or connection for pipes or rods; as, a *pipe coupling* or *union joint*.

Union Coupling.—A term sometimes applied to a right and left handed turn-buckle or sleeve nut, whereby two parts may be connected and drawn together without turning anything but the coupling.

Unionism.—The principles, or the system of combination among workmen engaged in the same occupation or trade.

Union Joint.—A pipe coupling, usually threaded, permitting disconnection without disturbing other sections.

Union Wrench.—In tools, a "tommy shaped" wrench used for tightening up the joints of union screws. It partially embraces the circular nut, and a hole drilled in the wrench slips over one of the horns cast on the side of the nut.

Unit.—In mathematics, any given quantity with which others of the same kind are compared for purposes of measurement. The fundamental units generally adopted are those of *length*, *mass*, and *time*.

Unite.—To put together or join, as two or more constituents, to form a whole; to combine; to connect; to attach; to join; to cause to adhere; as, to *unite* bricks by mortar.

Unit of Heat.—That which is required to raise 1 lb. of water, at 39 degrees Fahr., 1 degree. If 2 lbs. of water be raised 1 degree, or 1 lb. be raised 2 degrees in temperature, the expenditure of heat is the same in amount, namely, two degrees of heat, and to express the mechanical equivalent of heat, the comparison lies between the unit of heat on the one part, and the unit of work, or foot pound, on the other.

Unit of Length.—This varies with different vocations or trades. In workshops, the *inch* is the customary unit; with building trades, the foot; in civil engineering the *yard* for roadmaking, and the *chain* for surveying; in navigation, the *fathom* for soundings, the *nautical* or sea mile for distance, the *knot* for speed.

Unit of Mass.—In mechanics, any definite weight employed in mechanical calculations; as, a *pound* or a *ton*.

Unit of Measurement of Light.—One candle power; this unit, as fixed by law and custom, is the consuming of 120 grains per hour of a spermaceti candle of which it takes six to make one pound.

Unit of Money.—One dollar; thus, if we wish to determine the magnitude of a sum of money we must take some piece of known value; as, a dollar, and show how many such pieces are contained in the given sum.

Unit of Numbers.—The figure one (1).

Unit of Pressure.—1. The atmospheric pressure at the sea level, or 14.7 pounds per square inch absolute.

2. A load equal to one avoirdupois pound on a surface of one square inch.

Unit of Surface.—In steam engineering is represented by the *square inch*.

Unit of Time.—In usual practice, one minute; thus, we say an engine makes so many revolutions *per minute*, and its performance is based upon that. This unit varies with the different professions.

Unit of Work.—The force required to raise one pound one foot high from the earth, in the atmosphere, no time being taken into account; it is known as the *foot pound*.

Units of Measure.—Any one of various denominations, such as *gallon, mile, inch, pound, yard*, etc., adopted as standards of measurements.

Universal.—1. Pertaining to all things, or applicable to every similar thing without exception.

2. Adaptable to any use; unlimited in its application or motion.

Universal Bend.—In machinery, two bends provided with a swivel joint, so that they can be turned round to any desired angle in relation to each other.

Universal Chuck.—A chuck having movable dogs on a face plate, so operated as to move radially simultaneously, to adapt them to grasp objects of varying sizes.

Universal Coupling.—In mechanics, one in which the parts united are capable of assuming various angular relations to each other. Also called a universal joint.

Universal Joint.—A contrivance used for joining two shafts or parts of a machine endwise, so that the one may give rotary motion to the other when forming an angle with it, or may move freely in all directions with respect to the other; as, by means of

a cross connecting the two forked ends of the two shafts. Since this joint cannot act when the angle of the shafts is less than 140°, a double joint of the same kind is sometimes used for giving rotary motion at angles less than 140°.

Universal Mill.—A rolling mill which has vertical rolls in front or behind the ordinary horizontal rolls, thus rendering it possible to roll very many sections with one set of rolls. Where reversing rolls are used, there are vertical rolls in front of the others as well as at the back. These vertical rolls are set to the desired width of the metal rolled, the horizontal rolls reducing it to the proper thickness.

Universal Milling Machine.—One whose range of operations includes many within the capacity of the machine. It has a table fitted with several motions, and a dividing head with change wheels, so that, spur, bevel and worm wheels, worms, hobs and all kinds of milling cutters can be produced upon it, as well as the ordinary operations of milling flat or grooved surfaces for general work.

Universal Scale.—In drawing, a scale used for drawing purposes upon which all proportional divisions in ordinary use are engraved in parallel rows. The objection to universal scales is that measurements, except when along the edges, must be taken off by dividers instead of being set off from the edge directly on the paper.

Universe.—The world; all created things viewed as constituting one system or whole.

Unlace.—1. To loosen by undoing a lacing; as, to unlace a shoe.

2. In navigation, to loosen, and take off; as, a bonnet from a sail, or to cast off; as, any lacing in any part of the rigging of a vessel.

Unlatch.—To open or loosen by lifting the latch; as, to unlatch a door.

Unlimited.—Not limited; having no bounds; as, an *unlimited* order as to price or quantity.

Unload.—To take the load from; to discharge a load of cargo; to disburden; as, to unload a ship.

Unlock.—1. To unfasten what is locked; as, to unlock a door or chest.

2. To open, in general; to lay open; to undo.

Unmoor.—In navigation, to cause to ride with one anchor less than before, after having been moored by two or more anchors; to loosen from anchorage; to weigh anchor.

Unnecessary.—Not necessary; not required under the circumstances; useless; needless, as, *unnecessary labor*.

Unpin.—To loosen from pins; to remove the pins from, to unfasten, as, to *unpin* a snatch block, to *unpin* a frame.

Unravel.—To disentangle, to disengage or separate the threads of; as, to unravel a rope.

Unsaturated.—1. Capable of absorbing or dissolving to a greater degree; as, an unsaturated solution.

2. In chemistry, capable of taking up, or uniting with certain elements or compounds, without the elimination of any side product; thus, ethylene and ammonia are *unsaturated*.

Unscale.—To divest of scales, to remove scales from.

Unscrew.—To draw the screws from, to loosen from screws to loosen or withdraw *anything*, as, a screw, by turning it.

Unshale.—In mining, to strip the shale, or husk from; to uncover

Unskillful.—1. Inexperienced, awkward; bungling; as, an unskillful mechanic.

2. Lacking discernment, injudicious, ignorant

Unslaked.—Not slaked; as, unslaked lime

Unsluice.—In hydraulics, to open the sluice or sluices of; to let flow, to discharge

Unstrain.—To relieve from a strain; to relax.

Unstrained.—Not strained, not cleared or purified by straining; as, unstrained oil.

Unwater.—In mining, to drain, to free from water by pumping or otherwise

U Packing.—A hydraulic leather packing whose section is that of the letter U inverted.

Upcast.—In mining, that shaft through which is discharged the foul air and smoke from the ventilating furnace, etc.

Upend.—A term used by outside erectors and structural workers to signify the

standing up of a heavy piece of work upon its end.

Uphand.—In blacksmithing, signifies the method of using a smith's sledge hammer for light work. The sledge is held in the left hand and lifted and thrown down by the right; the latter slides freely up and down the shaft or hammer handle.

Uphand Sledge.—In blacksmithing, a term which denotes the lifting of the sledge over the work, in opposition to "*about sledge*."

Uphroe.—1. In navigation, a long piece of wood with several holes, through which pass the cords by which the ridge of an awning is held up. It is grooved on the outside, to receive the rope by which it is suspended. The uphroe and its cords form a *crow's foot*; sometimes spelled *euphroe*.

2. An analogous device, as also adapted in some forms of *bag holders*.

Upkeep.—A railroad term denoting *maintenance*; expenditure to keep anything in good condition and repair.

Upper.—1. Higher than something else; being above; opposed to *lower*; as, the upper deck.

2. The part of a boot or shoe above the sole and welt, and forward of the ankle seams.

Upright.—1. In carpentry, a pillar or post in a frame or other structure.

2. In steam engineering, a term synonymous with *vertical*, as applied to a boiler whose height is greater than its width, and to a steam engine in which the stroke is perpendicular.

3. In woodworking, a term applied to a moulding machine whose mandrel is perpendicular.

Upright Steam Boiler.—A type of steam generator known as a vertical tubular boiler. The outside casing or shell is cylindrical in shape, and is composed of iron or steel plates riveted together. The top is slightly dome shaped, except at the center, which is cut away to receive the chimney. The interior consists of a furnace chamber, and the bottom is occupied by the grating, on which rests the incandescent fuel. The bottom of the furnace is firmly secured to the outside shell of the boiler. The furnace crown plate is perforated with a number of circular holes of from one and a half to three inches diameter, according to the size of the boiler. Into each of these holes is fixed a vertical tube made of brass, wrought iron, or steel. These tubes pass through similar holes at their ends in the top plate. They serve to convey the flame, smoke, and hot air from the fire to the smoke box and the chimney. In these boilers, the water is contained in the space between the shell of the boiler, the furnace chamber, and the tubes.

There are two types: (1) those with submerged tubes, and (2) those with through tubes extending to the upper head of the boiler.

Upset.—1. To overturn or to cause to overturn.

2. To enlarge by blows upon the end; as, a blacksmith upsets a bar of heated iron by bumping its end upon the anvil, etc.

Uptake.—In a steamship, the conduit or casing, more or less rectangular in section, leading from the fire tubes to the funnel proper; any conduit or pipe leading upwards.

Upward Filter.—A filter in which the flow of the liquid is upward, giving a certain degree of facility for cleansing the material, by directing a current of clean water in the reverse direction, thus giving it a downward discharge, removing the sediment.

Uranium.—In chemistry, an element of the chromium group, found in certain rare minerals; as, pitchblende, uranite, etc., and reduced as a heavy, hard, nickel white metal, which is quite permanent. Its yellow oxide is used to impart to glass a delicate, greenish yellow tint which is accompanied by a strong fluorescence, and its black oxide is used as a pigment in porcelain painting.

Urchin.—In weaving, one of a pair of rapidly revolving small card cylinders, arranged around the periphery of a large card drum.

U. S. A.—Abbreviation for the United States of America, or United States Army.

Use.—The act of employing anything or applying it to one's service; application; as, the use of books in study; to make use of; to convert to one's service; to employ; to put to one's service; to accustom; to habituate; to render familiar by practice; as, men are used to labor and hardships.

U Section.—Material formed by rolling, pressing or casting into a cross section, like the letter U or Ω .

U. S. N.—Abbreviation for United States Navy.

Utility.—1. The state or condition of usefulness; aptness for service.

2. In mechanics, an appliance adapted for use in connection with larger or more important machinery; a useful contrivance; an adjunct to increase efficiency.



V.—1. The twenty-second letter in the English alphabet.

2. A *v* shaped piece, or two pieces at an acute angle; as, a part of a construction; as, the timber formed a *v*.

3. A shop term for a *five dollar bill*.

Vacant.—1. Deprived of contents; not filled; empty; as, a vacant factory room.

2. Unengaged with business; unemployed; unoccupied; disengaged.

Vacate.—1. To make vacant; to leave empty; to cease from filling or occupying.

2. To annul; to make void; to deprive of force; to make of no authority or validity; as, to vacate proceedings in a cause.

Vacuo.—In physics, a term used in calculations on the behavior of falling bodies and liquids, by which their velocity is referred to that of a body falling in a vacuum, or *in vacuo*.

Vacuum.—Containing or holding nothing; space empty or devoid of all matter or body; a word largely used in steam engineering.

Vacuum Box.—In paper making, a term applied to two boxes, under the traveling wire of the paper machine, in which a suction is maintained to deprive the moving web of water as it travels over them. These appliances are also known as *suction boxes*.

Vacuum Brake.—In railroad operation, an automatic, continuous brake, in which atmospheric pressure on a piston against a partial vacuum, furnishes the power of application. Each car has its own brake cylinder connected by a train pipe running the whole length of the train, which furnishes the means of control. An ejector on the locomotive exhausts the air from the train pipe and cylinders to release the brake, which is applied by the admission of atmospheric air into the pipe. This admission may be effected either by the engineer, brakeman, or automatically by parting of the train or accident to the brake.

Vacuum Cleaner.—An apparatus for removing dust from furniture or upholstery

by means of suction. An air pump is used to exhaust the air from a vacuum chamber, the entrances into which are provided with strainers of various dimensions of mesh. From this vacuum chamber lead flex-

ible pipes, each terminating in a cock and a wide mouthpiece. The suction of the pump draws dust through the mouthpieces into the system, and it is carried into suitable receptacles, the screens preventing its entrance into the pump.

Vacuum Dashpot.—A dashpot for use with Corliss or other trip gear; the piston fitting tightly in the pot, so that a vacuum is created behind it as the valve gear is pulled forward during admission. Upon tripping, the pressure of the atmosphere on the open side, causes the dashpot to close the valve suddenly.

Vacuum Engine.—In steam engineering, an early form of condensing engine, using very low pressure steam and receiving most of its power from the vacuum.

Vacuum Gauge.—An instrument resembling a steam gauge in construction, for measuring the unbalanced pressure of the atmosphere upon condensers, etc.

Vacuum Line.—A line ruled on an indicator diagram below the atmospheric line, at a distance corresponding to 14.7 lbs., on the scale of the spring, thus showing the *absolute vacuum*.

Vacuum Machine.—A refrigerating apparatus, principally for domestic use, in which water, under the influence of vacuum maintained by a hand pump, and in connection with a supply of sulphuric acid to absorb moisture, is rapidly frozen.

Vacuum Pan.—In sugar making, a closed vessel heated by steam, in which syrup is evaporated at a lower temperature than the ordinary boiling point, in consequence of a partial vacuum produced in the vessel by the condenser,

Vacuum Pump.—A sort of *pulsometer* in which a vacuum is created by the condensation of steam admitted into the pump chamber; the water which rises into the suction is blown out by a fresh supply of steam, which then condenses, creating the vacuum anew.

Vacuum Relief Valve.—An inverted safety valve, fitted to certain boilers, so that, if the pressure falls below that of the atmosphere, the valve will open and restore equilibrium. A similar valve is often fitted to locomotive cylinders, to destroy any vacuum set up by the pistons running with steam off, thus avoiding the tendency to draw sparks and ashes into the cylinders and valve chest.

Vade Mecum.—A book or other thing that a person carries with him as a constant companion; a manual; a handbook.

Valise.—A small trunk or portmanteau, to hold a traveler's equipment, or mechanic's small tools.

Valley.—In carpentry, the V or hollow at the base of two slopes on a roof; the internal angle formed by the meeting of two inclined sides of a roof.

Valley Rafters.—In building, rafters disposed about the internal angles or valleys of a roof.

Valley Tile.—A V or trough shaped tile to fit in the valley of a house roof, thus obviating flashing and preventing leakage.

Value.—1. The market price of anything.
2. Precise worth according to inherent qualities.
3. Amount of usefulness, or efficacy.
4. The importance or true signification of anything.

Valve.—A lid or cover to an aperture, so formed as to open a communication in one direction, and close it in the other by lifting, turning, or sliding; thus, the valve of a common pump opens upward to admit the water and closes downward to prevent its return.

Valve Box.—In steam engineering, the box or casing, rectangular or otherwise, in which the valves of pumps are placed. Also the steam chest which contains the slide valve of an engine.

Valve Bucket.—In hydraulics, a bucket provided with a valve; the bucket or *sucker* of a pump.

Valve Chamber.—The casing, chest or chamber attached to a cylinder or pump body, in which a valve or valves operate.

Valve Chest.—The steam chest of an engine; the more or less rectangular compartment attached to a steam cylinder, in which works the slide valve.

Valve Chuck.—In machine tools, a special chuck for holding a slide valve in a planing machine.

Valve Circle.—In steam engineering, the circle on a valve diagram whose diameter is equal to the travel of the valve.

Valve Cock.—A form of faucet in which the closure of the passage is by a valve on a seal.

Valve Diagram.—In steam engineering, a diagram by which the position of the slide valve for any position of the piston, may be determined graphically. As a consequence, the relative positions of the valve and piston at the instants of opening, cut off, cushioning, release, may also be determined. There are numerous modes of constructing valve diagrams. Those mostly used in valve motion design are known as the *Bilgram* and the *Zeuner* diagrams.

Valve Face.—That part of a surface which comes in contact with the seat; that portion of a cylinder on which the slide valve travels.

Valve File.—A file with two acute and two obtuse angles; used in filing valve and key ways.

Valve Gear.—The mechanism which controls the motion of the valves admitting and exhausting to or from the cylinders of an engine. With a locomotive, a prime necessity is that the gear shall run equally well in either direction, be reversed rapidly, and be suitable for a high rate of speed and correspondingly frequent alterations of motion.

Valve Grinding.—The operation of removing pits, corrosion and other marks from the faces and seats of disc or poppet valves. The surfaces are smeared with an abrasive and rotated in contact with each other, the high places being worn away, leaving two smooth corresponding faces.

Valve Lifter.—A device used to raise a poppet or drop valve from its seat; as, in overhauling a gas or other engine.

Valve Rings.—On a piston valve, rings let into the faces to secure a steam-tight working fit.

Valve Rod.—In steam engineering, a steel shaft attached to a rocker arm or link block at one end, and to a valve stem at the other; for communicating the motion of an eccentric rod to a valve.

Valve Rope Knife.—An emergency tool used in well boring on the cable system, consisting of a cylinder with a knife balanced in it like a valve in a pump. The tool is lowered around the rope till the desired depth is reached, when an upward pull engages the knife and severs the rope.

Valve Seat.—The fixed surface on which the valve rests or against which it presses.

Valve Setting.—The act or process of adjusting the valves of a steam or other engine so that the various cycles of admission, expansion, exhaust and compression occur at the proper periods.

Valve Slam.—An action akin to *water hammer*, occasioned by the violent or sudden closing of the valves of a pump, etc.

Valve Spindle.—The stem or stalk by means of which a valve is operated; the same as *valve stem*.

Valve Spring.—A spiral spring used to close lift valves promptly, such as those controlling the admission and exhaust of a gas engine, or the inlet and delivery of a pump. Also the springs sustaining the balancing arrangements of a slide valve.

Valve Steam Jaws.—The two arms of a valve stem bracket by which it is attached to the cylinder casting.

Valve Stem.—The rod or spindle to which a valve is directly connected and by which it is operated. Also called *valve spindle*.

Valve Stem Bracket.—On a steam engine, a bracket projecting beyond the stuffing box and having at its end a bearing for the valve stem to receive any sidewise thrust imparted by the eccentric rod.

Valve Tower.—In hydraulics, a tower or structure rising within a water works dam, and containing the valves controlling the passage of the water to the outlet conduit.

Valve Travel.—The length of the movement made by the slide valve upon its face.

Valve Yoke.—In a steam engine, a bridle or hoop formed in a valve stem, which embraces the central box of the valve, thus affording attachment to it.

Valvule.—In mechanics, a little valve; a valvelet.

Vamp.—1. The part of a boot or shoe upper in front of the ankle seams.

2. Something added to an old thing to give it a new appearance; as, paint on an old boiler.

Van.—1. A large covered wagon.

2. A shovel used in sifting ore. A peculiar rocking motion is given to the shovel, separating the ore powder into grades of varying gravity. This is called *vaning*.

Vanadium.—A rare element coming between phosphorus and arsenic. In its physical properties it resembles a metal; in its chemical properties, a non-metal. It melts at about 3000° F., and has a specific gravity of 5.5. It is widely distributed in small quantities, and is used to *alloy steel*, having the property of prolonging the life of that metal when exposed to rapidly reversed strains or shocks.

Vane.—1. The thin web part of a bird's feather.

2. A thin plate or strip of metal pivoted on the top of a spire or mast to show the direction of the wind. A *weathercock*.

3. A blade of a windmill, fan, *centrifugal pump*, or similar apparatus.

Vang.—1. A guy running from a gaff or derrick to a ship's side or rail to hold it steady, or slue it when working cargo.

2. To receive; earn; throw; catch.

Vanishing Point.—In drawing, the distance point at which all the parallel lines appear to meet.

Vanner.—In mining, a concentrating machine for fine sands and slimes, in which an endless india rubber belt travels over rollers at a slight inclination, and is shaken sidewise by a crank. A stream of clean water is directed upon the belt near its highest point, above the place where the *ore* water is fed on, both in a direction opposite to the travel of the belt. Such particles as are heavy enough to resist the stream of water are carried over the top and worked off in a tank beneath, while the higher waste portion is carried down the belt into the waste launder.

Vanning.—An operation for testing the quality of auriferous sand, or of ore when stamped.

Vapor.—1. Moisture in the air; any light cloudy substance in the air; as, smoke or fumes.

2. In physics, the semi-gaseous state of a substance which is liquid at ordinary temperatures; as, water in the state of saturated steam.

Vapor Burner.—A device for burning volatile hydrocarbons, in which the supply of illuminant passes through a coil or pipe heated by the flame and is therein vaporized.

Vapor Engine.—Aero steam engine; alcohol engine; ammonia engine; gas engine; etc.

Vapor Gas.—Atmospheric air saturated with the vapor of gasoline, used for an illuminant in large isolated buildings, where a small automatic apparatus for the generation of this gas is easily installed and worked. Under the name of *carbureted air*, this gas is also employed for driving gas engines of small size, or for starting those of large power.

Vaporize.—To pass off in vapor; to escape and be dissipated either in visible vapor, or in particles too minute to mention.

Vaporizer.—The device, attached to an oil engine, which vaporizes the fuel. It requires to be heated by means of a lamp to start the engine, but is thereafter kept at its proper dull red heat by the heat of the exhaust gases.

Vaporizing Surface.—The part of the heating surface of a steam boiler actually in contact with the water.

Vapor Lamp.—A lamp fitted with a vapor burner, or a contrivance in which the combustible is vaporized by the heat of its flame.

Variable.—1. Possessing the quality of variation or alteration; changeable or likely to change.

2. In mathematics, a quantity subject to continual increase or decrease.

Variable Blast Nozzle.—In a locomotive, a tip for an exhaust pipe that can have the area of its orifice altered by means of hinged flaps or cones operated by levers from the foot plate.

Variable Cut Off.—One actuated from the governor, so as to be brought into action according to the load on the engine.

Variable Expansion.—A steam engine is said to have variable expansion when the admission valves are controllable by hand, while the engine is running. Where a separate expansion valve is fitted, it may be effected through shortening its travel by means of a *shifting link*, etc. The Corliss or drop valves of low pressure engines usually have their trips regulable by hand, while Meyer expansion plates, adjustable by a hand wheel on the spindle, are frequently fitted with apparatus for the same purpose.

Variable Speed Gear.—A device comprising stepless speed cones or expanding pulleys by means of which the speed ratio existing between two shafts may be modified without the necessity of shifting the belt, etc. A round or rope belt, riding over guide or tension pulleys is usually employed on expanding pulleys, a flat sewed one on plain speed cones.

Variable Speed Pulley.—Arrangements of pulleys and gearing for transmitting different speeds.

Variable Speed Wheel.—A contrivance for obtaining alternately accelerated and retarded circular motion.

Variation.—The extent to which a thing varies; the degree or amount of departure from a former position or state; amount or rate of change.

Variety.—The quality or state of being various; intermixture or succession of different things; diversity.

Various.—1. Different; several; manifold; as, men of various occupations; *various* colors.

2. Changeable; uncertain; inconstant; variable.

3. Variegated, diversified; not monotonous.

Varnish.—1. A viscid liquid consisting of a solution of resinous matter in an oil or a volatile liquid, laid on work with a brush, or otherwise. When applied the varnish soon dries, either by evaporation or chemical action, and the resinous part thus forms a smooth, hard surface, with a beautiful gloss, capable of resisting, to a greater or lesser degree, the influence of air and moisture.

2. That which resembles varnish, either naturally or artificially; a glossy appearance.

Varnish Lens.—A small lens made by putting a drop of copal on a flat piece of oiled glass. It congeals into a *plano convex lens*.

Vary.—To suffer a partial change; to become different; to be modified; as, colors vary in different lights.

Vase.—A vessel commonly of pottery, but sometimes of stone or glass, usually of a circular bulging body, supported by a base and used for containing articles of value; an ornamental hollow vessel.

Vaseline.—A yellowish, translucent substance, almost odorless and tasteless, obtained as a residue in the purification of crude petroleum, and consisting essentially of a mixture of several of the higher members of the *paraffin* series. It is used as an unguent, and for various purposes in art, and in its more crude state to grease concrete forms.

Vat.—1. A large vessel, or cistern; a large cask like receptacle, especially one used for holding liquids.

2. A wooden tub for washing ores and mineral substances.

Vatman.—In paper making, the workman who dips the wire cloth mould into the vat of pulp, taking up sufficient to form a sheet of paper. This is prevented from flowing over by the *deckel*, while the vatman strikes off with a straight edge, the superfluous pulp, and by a shaking motion causes much water to run through the wires, which settles the pulp evenly.

Vault.—1. In architecture, a passage or room with an arched ceiling. An extended arch covering an apartment.

2. A cellar like place for storage; as, the treasury *vaults*.

Vault Cover.—A lid over a hole through a pavement. The hole may have a movable cover to be removed when coal is to be emptied into the vault; or, it may be for light or ventilation, or both.

Vault Light.—A cover for a pavement coal hole, or a section of sidewalk; partially glazed, to illuminate the vault beneath.

V Block.—In machine shop practice, a carefully planed block of steel or cast iron with a V on one side, intended to be used in pairs to support shafts or other cylindrical objects on the marking off plate, or, on the table of a planing machine, etc.

V Bob.—A form of bell crank, used to change the direction of motion; as, the horizontal motion of the crosshead of a steam engine to the vertical motion of a pump rod working in a mine shaft.

V Crose.—A cooper's tool for forming a triangular heading groove in the staves of a cask or barrel.

V Edges.—In metal working, the edges of automatic metal working machines which are embraced by the sliding vee'd portions of the movable parts. The edge of a lathe bed embraced by the sliding rest, or the edge of the cross travel of a planing machine are familiar cases in point. The angles of those edges are commonly 60 degrees.

Veer.—1. To direct to a different course or direction; to turn; to wear; as, *to veer a vessel*.

2. In navigation, "to veer and haul," to pull tight and slacken alternately; "to veer away or out," to slacken and let run; to pay out; as, *to veer away the cable*; *to veer out a rope*.

Vegetable Oils.—In lubrication, many oils used for lubrication are obtained from the seeds of vegetables; as, castor, cotton, nut, etc. These oils are expressed from the seeds by pressure, or by pressure and heat.

Vegetable Size.—In paper making, the resin or gum added to the pulp in the engine.

Vegetable Wax.—An excretion from certain plants, having the consistency and appearance of wax. It occurs sometimes on the surface of the leaves and fruit, forming a bloom or glaucous substance, which preserves from wet. It is sometimes obtained by bruising and boiling the plant, or parts of it, in water, when it floats on the surface, and concretes in cooling.

Vehicle.—A car, carriage or other conveyance.

Vein.—In mining, a body of ore, disseminated through a rocky mass having more or less regularity, and defined walls; the same as *lode*; a body of ore filling crevices or cavities in the earth, as distinguished from deposits or *beds*.

Veinstone.—In mining, *gangue*; the rock with which the ore is mingled in the vein.

Velinche.—Sometimes called a *thief tube*. A tube open at both ends, the lower orifice being so contracted that while the finger is closed upon the upper end, liquid will not issue from the lower. It is used in obtaining samples or small quantities of liquids from casks. Also known as a *sampling tube* or *sampler*. Also called the *sucking tube* or *monkey pump*, by sailors. It is a straw or quill introduced through a gimlet hole into the barrel, to draw the liquid therefrom. A rye straw

applied to a barrel of cider is a familiar illustration. It has also the merit of being at least as old as Xenophon, who describes this mode of pilfering from the wine jars of Armenia.

Velocimeter.—An apparatus for determining the velocity of projectiles, depending upon the rupture of the two wire screens for the making and breaking of the circuits which actuate the recording mechanism.

Velocipede.—An early type of bicycle; the first with the high front driving wheel and small hind wheels, and made with a wooden or iron frame.

Velocity.—The speed at which a body moves; *i. e.*, the space which it traverses in a given time.

Velograph.—A type of tachometer or speed indicator which makes a permanent record of the speeds and times which it indicates.

Velvet.—A silk fabric, in which the warp is passed over wires, so as to make a row of loops which project from the backing, and are thus left, by withdrawing the wire, for an *uncut* or *pile velvet*, but are often cut by a knife to make a *cut velvet*.

Velvet Loom.—In weaving, one constructed with pile wires and other devices for weaving piled fabrics.

Vena Contracta.—In hydraulics, the contraction in area which a jet of water or other outflowing liquid undergoes in issuing from an orifice. The smallest diameter of the vena contracta is about .79 of that of the orifice; the distance, at which the contraction takes place from the opening, being about half its diameter.

Vend.—1. The act of vending or selling.

2. The total sales of coal from a colliery.

Vending Machine.—An automatic machine which is provided with a magazine containing small packages of sweetmeats, postal cards, etc., one package being released at a time from the machine, by means of the clockwork within, the latter being actuated by the weight of a coin of the proper denomination dropped in a slot on the casing.

Veneer.—In woodworking, a thin slip of wood or ivory, glued or cemented to a

piece of other material, and forming an ornamental covering thereto.

Veneering.—1. The process of covering the surface of an object with a thin sheet or sheets of more ornamental material, in order to improve its appearance.

2. In paper making, the process of covering a sheet of one quality or color of paper by a second sheet of differing quality or texture.

3. In pottery, a process termed *veneering* has been adopted with some kinds of pottery, where a strong, but coarse and unsightly ware, is dipped, while in the biscuit condition, into a paste of superior color and quality, so as to cover the biscuit with a desirable coating, whose colors are intensified by a glaze. The inside and outside may be of different colors.

Veneer Punch.—A sort of punch for cutting out oval, circular, or ornamental pieces of veneer, for purposes of inlaying.

Veneer Saw.—In woodworking, a circular saw, made thick at the middle, and tapering to a very thin edge at the periphery; used for separating veneers from the solid block.

Venetian.—Of, or pertaining to Venice, Italy; as, *Venetian glass*.

Venetian Blind.—A lower shutter or blind made of slats, with spaces between them to admit air. In some cases the slats are fixed at a certain angle in the shutter, in other cases they are movable to allow the passage of more or less air and light.

Venetian Enamel.—An enamel used for the dials of clocks and watches.

Venetian Tile.—A form of roofing tile with raised edges, used in connection with cover tiles.

Vent.—1. In mechanics, an outlet of any kind, commonly small, for the passage of something; as, air or water, out of or into a confined place.

2. In plumbing, an upright pipe carried above the highest part of a house, for the purpose of ventilating soil pipes, drains, etc.

3. In founding, an opening to a mould to permit air and gases to escape.

Ventilate.—To produce a free circulation of air in; as, by means of open shafts, windows, doors, etc.; as, to admit fresh air into a room.

Ventilating Brick.—A brick having perforations permitting the passage of air for heating, ventilation, etc.

Ventilating Bucket.—In hydraulics, in overshot water wheels the water as it descends into the buckets would be partially driven out again, by the reaction due to the compressed air within the buckets, but for the precaution of leaving a slight opening between the bucket and sole plate, through which the air escapes; hence, the term.

Ventilating Fan.—In machinery, a blowing machine, either of rotary or centrifugal type, used for ventilation.

Ventilating Flues.—The passages or conduits used to conduct fresh air in a ventilating system.

Ventilating Saw.—A saw with perforations in the blade, to keep it from heating and twisting and to assist the escape of cuttings.

Ventilation.—1. The art or process of replacing foul air by that which is pure, in any enclosed place; as, a house, a church, mine, etc.
2. Free exposure to air.

Ventilator.—A passage or duct to admit fresh air or afford egress for foul.

Venting.—In a foundry, the venting of a mould is the piercing or honeycombing of the sand of which it is composed, by a long rod of $\frac{1}{4}$ inch or $\frac{1}{2}$ inch wire, thrust in all directions, to allow the free egress of the gases generated by the decomposition of its moisture, consequent on the heat imparted thereto by the inflowing of the molten metal.

Venting Wire.—In founding, a piercer used to make vent holes in the mould.

Vent Pipes.—In founding, lengths of common piping leading up at an angle from the coke bed of a mould, to bring off the escaping gases and carry them outside the edges of the moulding box, where they become ignited and burnt.

Ventres.—In hydraulics, elongated swellings formed in a stream or vein of liquid, issuing from an orifice, at some distance below the latter.

Vent Rope.—In a foundry, common rope or string rammed up in certain cores and in certain sections of moulds in situations where it would be difficult or impossible to ram up the usual vent wires, by reason of the winding about of the vents. After the ramming is complete, the rope or string is withdrawn, leaving the vent or vents curved as required; also called *vent string*.

Venture.—1. An undertaking of chance or danger; the risking of something upon

an event which cannot be foreseen with certainty; a hazard; a risk.

2. An event that is not, or cannot be foreseen; an accident; chance; hap; contingency; luck.

3. The thing put to hazard; a stake; a risk; especially, something *sent to sea in trade*.

Veranda.—In architecture, an open roofed gallery or portico adjoining a dwelling house, forming an out of door sitting room.

Verd Antique.—1. In architecture, a molten green serpentine marble.

2. A green porphyry called *oriental verd antique*.

Verdict.—1. The answer of a jury given to the court concerning any matter of fact in any cause, civil or criminal, committed to their examination and determination, the finding or decision of a jury on the matter legally submitted to them in course of the trial of a cause.

2. Decision; judgment; opinion pronounced; as, to be condemned by the verdict of the public.

Verdigris.—1. A green, poisonous substance used as a pigment and drug, obtained by the action of acetic acid on copper, and consisting essentially of a complex mixture of several basic copper acetates.

2. The *green rust*, formed on copper.

Verge.—1. In architecture, the shaft of a column; or a small ornamental shaft.

2. The spindle of a watch balance.

3. The extreme side or edge of anything which has some extent of length; the brink, edge; margin.

4. In building, that edge of the tiling, or shingles of a roof, which projects over the gable end, as distinguished from the projections over the side walls, which are termed *eaves*.

Verge Board.—The ornament or woodwork upon the gable of a house.

Vermilion.—This is a bright red heavy paint made by heating sulphur and mercury together. Vermilion should always have a coat of varnish for outside work, and should not be mixed with white lead, on account of the sulphur which it contains.

Vernacular.—1. Belonging to the country of one's birth; one's own by birth or nature; native; indigenous; now used chiefly of language; as, English is our *vernacular* language.

2. One's mother tongue; often, the common forms of expression in a particular locality.

Vernier.—A small movable scale invented by Pierre Vernier in 1631, and used for measuring a fractional part of one of the equal divisions on the graduated fixed scale.

The vernier consists in its simplest form of a small sliding scale, the divisions of which differ from those of the fixed primary scale. On the scale of the tool is a line of graduations divided into inches and numbered 0, 1, 2, etc., each inch being divided into ten parts, and each tenth into four parts, making forty divisions to the inch. On the sliding jaw is a line of divisions of twenty-five parts, numbered 0, 5, 10, 15, 20, 25. The twenty-five divisions on the vernier correspond, in extreme length, to twenty-four divisions, or $\frac{24}{25}$ of an inch, on the scale; each division on the vernier is, therefore, $\frac{1}{25}$ of $\frac{24}{25}$, or $\frac{24}{625}$ of an inch shorter than the corresponding division on the scale.

If the vernier is moved until the line marked 0 on the vernier coincides with that marked 0 on the scale, then the next two lines to the right will differ from each other by $\frac{1}{625}$ of an inch; and the difference will continue to increase $\frac{1}{625}$ of an inch for each division, until the line 25 on the vernier coincides with a line on the scale.

Vernier Calipers.—An instrument for accurate measurement, consisting of two L shaped pieces, one sliding on the other. The bar of the main piece is marked to a standard scale, say 40 to the inch, the sliding part is supplied with a vernier scale, 25 of whose graduations correspond to $\frac{24}{25}$ on the main scale. The fine measurement is, therefore, $\frac{24}{25} \times \frac{1}{25} = \frac{24}{625}$ inch or .001. The sliding part is usually made in two parts for quick setting, being roughly set to size, the outer slide clamped, and the inner jaw carefully set by a horizontal adjusting screw.

Vernier Compass.—A surveyor's compass whose compass circle, with a vernier attachment, is movable about a common center by turning a tangent screw at the south end of the instrument. It is adapted to retrace the lines of old surveys where the variation of the compass has changed.

Vernier Transit.—A surveyor's transit having a vernier attachment to the compass by which the latter may be adjusted to indicate the true instead of the magnetic bearings.

Versed Sine.—1. In mechanics, the rise of an arch.

2. In trigonometry, that part of the diameter of an arc intercepted between the extremity of the arc and the foot of the sine.

Vertex.—1. A turning point; the principal or highest point; top; summit; crown; apex.

2. In mathematics, the point in any figure opposite to, and furthest from the base; the

terminating point of some particular line or lines in a figure or a curve; the top, or the point opposite the base.

Vertex of an Angle.—The point in which the including lines meet.

Vertical.—Perpendicular to the plane of the horizon; upright; plumb; as, a vertical line.

Vertical Boiler.—In steam engineering, an upright boiler.

Vertical Drill.—One with a vertical or upright spindle.

Verticals.—In structural iron work, the upright members of a lattice girder.

Vessel.—1. A hollow utensil for holding anything, more especially liquids and fluids.

2. A hollow structure built to float on water for purposes of conveyance, and provided with means of propulsion; a ship.

Vestibule.—1. An open court or porch before a building; a hall or lobby next to the entrance of a house.

2. A covered passageway from one railway car to another.

Vestibule Car.—In railway operation, a car having arched doorways at the ends, with bellows like extensions on a series of spring buffers touching the next car, thus providing a covered way from one car to another, preventing racking strains through sudden stoppages, and lessening oscillation of the cars while in motion.

V Gear Wheel.—In machinery, a duplex arrangement of skew gearing in which each tooth is of a shape of the letter V.

V Guideways.—In a planing machine, the grooves in the bed, shaped to an angle of 60°, usually, in which slide corresponding angular strips on the bottom of the table.

V Hook.—An eccentric rod gub having V shaped jaws.

Viaduct.—An elevated road for the passage of vehicles. Bridges are viaducts; but the latter term is especially applied to arched or truss structures which cross valleys or gorges where the width of the water course is but a fraction of the distance traversed. Viaducts are constructed where the depth renders embankments impracticable.

Vial.—A small long bottle, closed with a stopper, and intended to hold liquids, especially liquid medicines.

Vibrate.—1. To move to and fro, or from side to side; as, a pendulum; an elastic rod, or a stretched string, when disturbed from its position of rest; to swing; to oscillate.

2. To have the constituent particles move to and fro, with alternate compression and dilatation of parts; as, the air, or any elastic body; to quiver.

3. To produce an oscillating or quivering effect of sound; as, a whisper *vibrates* on the ear.

Vibration.—1. The act of vibrating, or the state of being vibrated, or in vibratory motion; quick motion to and fro; oscillation; as, a pendulum or musical string.

2. In physics, a limited reciprocating motion of a particle of an elastic body or medium in alternately opposite directions from its position of equilibrium; when that equilibrium has been disturbed, as when a stretched cord or other body produces musical notes, or particles of air transmit sounds to the ear. The path of the particle may be in a straight line, in a circular arc, or in any curve whatever.

Vibrator.—A spring mounted tongue or blade which is actuated by the magnet of an induction coil, and by its vibration or trembling produces a rapid succession of sparks, instead of a single one at the moment of ignition, in an internal combustion engine. This vibrator or *trembler* is generally used in a jump spark, high tension, ignition device.

Vibratory Motion.—In physics a rapid motion back and forth; especially, the repeated motion of the parts of an elastic solid, or of a fluid of which the normal condition has been disturbed, like the waves.

Vicinity.—That which is near, or not remote; that which is adjacent to anything; adjoining space or country; neighborhood.

View.—In drawing, a representation of any object or scene as observed from a particular point of vision. More especially in technical drawing, the representation being qualified by the name of the view point; as, *front view*, *end view*, etc.

Vinculum.—1. A bond of union; a tie.
2. In mathematics, a straight, horizontal mark placed over two or more members of a compound quantity, which are to be subjected to the same operation.

Vinegar.—A solution of acetic acid in water, formed by the oxidation of alcohol under the influence of a ferment, *mother of vinegar*. *Brown or malt vinegar* is made by exposing beer, mixed with a little yeast, to the air, the alcohol of the beer changing to acetic acid. *White wine vinegar* is prepared by the oxidation of the alcohol contained in white wines, the wine being allowed to trickle over birch twigs or deal shavings in towers, thus freely exposing the alcohol to the action of the oxygen in the air. Malt vinegar is made on a commercial scale by means of the latter process, a wort with added alcohol being passed through the twigs or shavings which are covered with growths of the ferment. At the last, a little sulphuric acid is added to prevent further changes in the vinegar.

Virtual.—Existing in effect, power, or virtue, but not actually; opposed to real, actual, literal.

Virtual Velocity.—In higher mechanics, a minute hypothetical displacement, assumed in analysis to facilitate the investigation of statical problems. Strictly speaking, it is not a velocity but a length.

Virulent.—Extremely poisonous or venomous; very active in doing injury.

Vis.—1. Force; power.

2. Physical force; moral power.

Vis à Vis.—1. One who, or that which, is face to face with another; especially one who faces another in lifting together, a heavy object.

2. A carriage in which two persons sit face to face. Also a form of sofa with seats for two persons, so arranged that the occupants are face to face while sitting on opposite sides.

2. A type of gas engine where two cylinders are placed facing each other on the same bed. Also known as *horizontal opposed* engine.

Viscometer.—An instrument for measuring the viscosity of liquids, either by noting the time it takes drops to traverse an inclined glass or porcelain slope, or by observing the time taken by a measured quantity to run out of a standard orifice into another vessel.

Viscosity.—The property possessed by liquids of resisting deformation. The idea is also associated with *stickiness*. For purposes of comparison, liquids are usually referred to water as 1; with lubricants, rape oil is taken as a standard. The usual method of measuring viscosities is by measuring the time taken by a known volume of the liquid, at a known temperature, in flowing through an aperture of known form and dimensions under a known pressure. Thus tested, water will flow rapidly, while castor oil is very sluggish, and hence possesses great *viscosity*.

Vise.—A clamping device consisting usually of two jaws made to be closed together with a screw, sometimes by a toggle or a lever, and commonly attachable to a bench; used for grasping or holding a piece of work that is being operated upon.

Vise Clamps.—A supplementary jaw, to hold pieces of peculiar shape, tender material, or a very thin size, in the jaws of a vise.

Visible.—Perceivable by the eye; capable of being seen; perceptible; as, the least spot is *visible* on white paper.

Visible Horizon.—The apparent limit that bounds the view of an observer; the line beyond which nothing can be seen at the earth's surface, especially at sea, where the circle includes the whole visible part of the ocean.

Vis Inertiae.—That property of matter, by which it tends when at rest to remain so, and when in motion to continue in motion.

Vision.—1. The act of seeing; the sense of sight.
2. Anything seen.

Visual Angle.—The angle formed by two rays of light, or two straight lines drawn from the extreme points of an object to the center of the eye.

Visual Ray.—In optics, the straight line in which light travels, from the object or source of light to the eye of the observer.

Vis Viva.—In physics, the active or living force of a body, or of the particles of which it is composed. It may be taken as the measure of the mass multiplied by the square of the velocity, although some writers take it as half this quantity.

Vitiate.—1. To render defective; to contaminate; to spoil; to injure the substance or quality of.
2. To cause to fail of effect, either wholly or in part.

Vitreous.—Consisting of glass; of, pertaining to, or derived from, glass, as, a *vitreous substance*; vitric.

Vitreous Enamel.—An enamel whose base or materials are of the nature of

glass, becoming hard on fusion, though not necessarily transparent.

Vitrics.—This term includes the fused compounds in which silex predominates, such as glass and some of the enamels; in contradistinction to the *ceramics*, in which alumina predominates; such as brick, tiles, pottery, and certain of the enamels.

Vitrification.—The act of changing into glass. Said of the melting of silex by heat, a process which is assisted by the addition of alkalies.

Vitriol.—1. A name given to *sulphuric acid* or some of its compounds, on account of their glassy appearance in certain states. *Blue vitriol* is hydrous copper sulphate; *green vitriol*, copperas; *red vitriol* is either a sulphate of cobalt or a ferric sulphate; *white vitriol* is hydrated zinc sulphate.

2. In chemistry, a sulphate of any one of certain metals; as, copper, iron, zinc, cobalt; so called on account of the glassy appearance or luster.

Vocation.—Destined or appropriate employment; calling; occupation; trade; business; profession.

Voice Tube.—In navigation, a speaking tube leading from the bridge to the wheel house, engine room, or other parts of the vessel.

Void.—1. Containing nothing; empty; vacant; not occupied; not filled.
2. Being without; destitute; wanting.

Voir Dire.—A law term; a preliminary examination of a person, especially of a proposed witness or juror, as to his qualifications for the duty in question; also, the *oath*, administered to the person so examined, to make true answers to the questions to be asked touching the matter.

Volante.—A cumbrous two wheeled pleasure carriage, used in Cuba and Central America.

Volatile.—Easily passing from the liquid into the gaseous state; such as ammonia or ether. Substances which affect the smell with pungent or fragrant odors; as, musk, hartshorn, and essential oils, are called *volatile* substances, because they waste away on exposure to the atmosphere. Alcohol and ether are called *volatile* liquids for a similar reason, and because they easily pass into the state of vapor on the application of heat. On the contrary, gold is a *fixed* substance, because it does not suffer waste, even when exposed to the heat of a furnace; and oils are called *fixed* when they do not evaporate on simple exposure to the atmosphere.

Volatile Fuel.—A liquid hydrocarbon of low specific gravity; such as, *benzine*, *gasoline*, *naphtha*, *petrol*, etc., all of which volatilize readily.

Volatilization.—The rapid evaporation of certain liquids, when exposed to the air at ordinary temperatures.

Volcanic.—Produced by a volcano; as, *volcanic tufa*.

Volume.—Dimensions; compass; mass; bulk; space occupied, as measured by cubic units; that is, cubic inches, feet, yards, and the like; as, a *volume of gas*.

Volumeter.—An instrument for measuring the volumes of gases or liquids, by introducing them into a vessel of known capacity.

Voluntary.—1. Proceeding from the will; produced in or by an act of choice.

2. Unconstrained by the interference of another; unimpelled by the influence of another; not prompted or persuaded by another; done of his or its own accord.

3. Done by design or intention; intentional.

Volute.—1. Rolled up in any way; giving a name to springs, sea shells, etc.

2. In architecture, a spiral scroll like ornament, used in Ionic and Corinthian capitals, pillars, or columns; a *scroll*.

Volute Spring.—A spring formed of a *spiral scroll* of plate, rod, or wire, extended or extensible in the direction of the axis of the coil, in which direction its elastic force is exerted and employed.

Volute Wheel.—A volute shaped shell, that in revolving presents its open mouth to the air, which is thus gathered into the tube and discharged through the hollow axis. It is a common and effective form of *blower*. The term, volute wheel is sometimes applied to a *water wheel* with radial or curved buckets, in which the periphery of the wheel is surrounded by a volute shaped casing or scroll, which confines the water against the wheel, gradually decreasing in size as it encircles the wheel.

Vomit.—In paper making, the discharge of boiling water over the interior surface of the *kier* or boiler, maintained by circulation through the central pipe.

Vortex.—A whirling or circular motion of any fluid, usually of water, forming a cavity in the center of the circle, and in

some instances drawing in water or absorbing other things; a *whirlpool*.

Vortex Blast Pipe.—In a locomotive, a form of exhaust pipe in which the blast nozzle is of an annular form, and draws the gases from the tubes through its center.

Vortex Ring.—A ring having motion in a direct line, moving upward or otherwise, and revolving inwardly upon the axis of its circumference: a round rubber band about a stick, as the band is forced along the stick, will rotate inwardly and furnish an example of vortex motion.

Vortex Water Wheel.—In hydraulics, a kind of turbine in which the water enters in a straight line at the surface and is discharged at the center with a whirling motion.

Vouch.—To back; to support; to confirm; to establish.

Voucher.—1. One who vouches, or gives witness or full attestation to anything.

2. A book, paper or document which serves to *vouch* the truth of accounts, or to confirm and establish facts of any kind; also, any acquittance or receipt showing the payment of a debt; as, the merchants' books are his *vouchers* for the correctness of his accounts; notes, bonds, receipts and other writings, are used as *vouchers* in proving facts.

Vousoir.—In architecture, one of the wedge like stones forming part of an arch, and placed in the middle of the crown. A *keystone*.

Voyage.—1. A passage either by sea or land; a journey, in general; a passage or journey to a distant place or country.

2. The act or practice of traveling.

3. Course; way.

V Point.—A V shaped point; a point formed, as by converging lines.

V Shaped.—Having the form of the letter V.

V's of a Lathe.—The V shaped ways upon which a lathe carriage slides.

V Strips.—In metal working, loose strips having angles corresponding with those of the v'd edges along which they slide and by means of which the amount of slack due to wear is taken up. Hence, called *adjustment strips*.

V Thread.—1. A screw thread formed by means of a sharp pointed tool, as contrasted with a square thread.

2. A standard thread for pipes, tubing, etc., with an angle of 60° between the sides.

V Threaded Screw.—In machinery, the ordinary screw of an angular thread. Formerly each manufacturer had his special screw rates designed without reference to uniformity with any other. Certain standards were adopted some years ago, and we now have the Whitworth thread in England, the Sellers thread in America, and the decimal thread in France.

V Tool.—A tool; as, a chisel, having dividing edges for cutting a V shaped groove.

Vug.—In mining, a cavity or hollow place in a lode.

Vulcanite.—India rubber mixed with a very large percentage of sulphur, and exposed to a high temperature for a considerable time, producing a substance altogether different from rubber. Vulcanite, or *ebonite*, as it is sometimes called, may be made as flexible as whalebone or as stiff as ivory, with many gradations between.

Vulcanization.—The art or process of imparting new properties to caoutchouc or rubber by causing it to combine with sulphur through the agency of a high temperature. This may be so done as to leave it soft and elastic, or to harden it into a substance like horn.

Vulcanizer.—A furnace in which the flasks containing the component parts are exposed to a heat sufficient to combine the *sulphur* and *caoutchouc*, and produce the compound called *vulcanite*.

Vulgar Fraction.—In arithmetic, a fraction in which the number of the equal parts, into which the integer is supposed to be divided, is indicated by figures or letters called the *denominator* written below a line, over which is the *numerator* indicating the number of parts included in the fraction; as, $\frac{1}{2}$ or $\frac{1}{it}$.

V Welding.—In boiler making, a mode of welding the plates of boiler flues in which there is neither butt nor lap properly so called, but in which a strip of square rod is inserted angle ways between the nearly abutting edges of the plate, so that it unites the edges upon two sides of the rod.



W.—The twenty-third letter of the English alphabet.

Wabblers.—In machine shop practice, an elliptical cutter head, placed at such obliquity on the shaft as to revolve in a circular path. Sometimes called a *drunken cutter*.

Wabble Saw.—A circular saw hung out of true on its arbor. Used in cutting dovetail slots, mortises, etc.

Wad.—A soft mass, especially of some loose fibrous substance, used for various purposes; as, for stopping an aperture, or the like.

Wade.—To walk in a substance that yields to the feet; to move sinking at each step; as, in water, mud, sand, etc. Hence, to move with difficulty or labor; to proceed slowly among objects or circumstances that constantly hinder or embarrass.

Wad Hook.—In mining, a hook or screen for extracting from a shot hole, undischarged powder or tamping.

Wages.—That for which one labors; stipulated payment for service performed; hire; pay; compensation given to a hired person for his or her services.

Waggle.—To reel, sway, or move from side to side; to move with a wagging motion; to waddle.

Wagon.—A four wheeled vehicle for the transport of commodities; the two front wheels are usually smaller than the others, and their axle is constructed to *swivel* so that corners may be easily turned.

Wagon Box.—The upper part or body of a wagon, generally used in construction, for removing sand, earth, stones, etc.

Wagon Drag.—A skid, shoe, or drag, to check the speed of a wagon on a down grade.

Wagon Dump.—A place where loads of rubbish, etc., are deposited; dumping

ground; a heap of matter on a waste place, especially the material piled at the mouth of a shaft.

Wagoner.—One who has charge of a wagon; one

whose business it is to drive a horse and wagon.

Wagon Hoist.—An elevator used in carriage factories, depots, and livery stables, to raise or lower vehicles to or from floors in the building. The platform is balanced by weights and pulleys over the respective corners.

Wagon Jack.—A jack or lift used to raise the axle of a carriage, wagon, etc., sufficiently to admit of removing a wheel for axle greasing or repairs.

Wagon Top Boiler.—A type of locomotive boiler, in which the barrel is connected to the outer fire box by a tapered or conical strake of plating. This flaring out of the fire box front gives ample supply of water to the fire box heating surface, and adds greatly to the steam room.

Wagonwright.—A maker of wagons; a *wainwright*.

Wain.—A carriage for the transportation of goods on wheels; a *wagon*.

Wainscot.—A peculiarly fine grained and knotless oak timber, not so liable to warp or crack as English oak, and easily worked. It was formerly imported from Holland for use in paneling or making a lining for the interior walls of buildings, usually, only *part of the way from floor to ceiling*. This was thence termed *wainscoting*, and the term has been extended to include all similar interior panel work, whether wainscot proper or not.

Wainwright.—One who does all the wood work in wagon making; also called *wagonwright*.

Waist.—The central and cylindrical part of a locomotive boiler.

2. In navigation, a narrow portion of an object; as, the contracted part of a Smeaton lighthouse; the middle portion

of an object; as, the midship part, between the forecastle and quarter deck; or the main and fore hatchways; or the half deck and galley.

Wale.—1. In shipbuilding, a wide plank at certain portions of a ship's side, extending from stem to stern, and describing the curve of the strakes. The wales are known as the *mainwale*; *gunwale*; *channel wale*.
2. In dock building, a timber bolted to a row of piles to secure them together and in position. Cal'd also *wale strip*.

Wale Piece.—A horizontal timber of a dock or jetty, bolted to the vertical timbers or secured by anchor rods to the masonry, to receive the impact of vessels coming or lying alongside.

Waling.—In civil engineering, horizontal boards or ribands which retain the vertical poling boards constituting the walls of a trench; the *struts* stretch from the waling board on one side to its mate on the other.

Walk.—To move along on foot; to advance by steps; to go on at a moderate pace; specifically, of two legged creatures, to proceed at a slower or faster rate, but without running or lifting one foot entirely before the other touches the ground.

Walking Beam.—A term applied to the beam or main oscillating lever in American type side-wheel steamers. An engine so built is called a *walking beam engine*.

Wall.—1. A continuous structure; as, of stone or brick, with a thickness small as compared with its length and height.

2. The side of any cavity, vessel, or receptacle.

3. In mining, one of the surfaces of surrounding rock enclosing a vein or lode.

Wall Anchor.—In erecting, a bar of iron with a plate or foot at right angles to it, built into the thickness of a brick wall; the bar end is spiked to a beam or floor joist, to tie the opposite walls together, the plate or foot being between the thicknesses of brick, or on the outside, secured by nuts or riveting.

Wall Bearing.—1. In machinery, a bearing for receiving a shaft when entering or passing through a wall. It is protected by a cast iron casing, built into the wall, the bottom of which serves as a bed plate for

the *plummer block*, the upper part supporting the masonry above.

2. In architecture, that part of a beam, girder or truss which rests on the wall.

Wall Box.—An arched frame of cast iron, set in the thickness of a wall, to enclose and support a *plummer* or *pillow block* for a shaft bearing. A wall box is frequently used to support the further end of an engine shaft, when it has an overhung or side crank, in lieu of a pedestal.

Wall Bracket.—A bracket bearing, projecting from a wall or post, serving to support a line of shafting; as, a *post* or *wall hanger*.

Wall Crane.—A light crane for shop use, pivoted upon bearings which are affixed to the wall of the building.

Wall Drill.—A portable drilling machine without pillar or standard, which may be attached to a wall or to any upright post for temporary work, or to suit special circumstances.

Wall Engine.—In steam engineering, a type of small vertical steam engine, whose bed plate is bolted to a wall. Such engines are convenient for driving sectional lines of shafting, as one set of shafting can then be stopped without affecting that in another shop, or in another part of the same shop. They are also used for driving traveling cranes, foundry fans, etc. The cylinders are lowermost and the crank shaft above.

Wall Flue.—In steam heating, the rectangular conduit placed against the wall, which conducts heated air from the *leaders* to the desired floor.

Wall Hanger.—Very similar to *post hanger*, or shafting support designed to fit against the *side of a wall*, standard or pillar.

Wallower.—A *trundle* or *lantern wheel*, in which the teeth are replaced by bars or round cylinders set in two discs.

Wallow Wheel.—A bevel wheel upon a vertical shaft with the teeth downwards, the reverse of a *crown wheel*.

Wall Paper.—Paper prepared for hanging upon walls to render them more sightly; or merely for the purpose of coloring them, as in photographic studios.

Wall Planer.—A machine tool for shaping large vertical surfaces. The work is bolted to a heavy horizontal bed, athwart which is the frame carrying the tools, this

being supported by a housing on either side. The tool cuts vertically as in a slotting machine, working up and down on a table or rest, which is fed across the transverse frame, as the work proceeds.

Wall Plate.—1. In building construction, a piece of timber or iron let into a wall to serve as a bearing for the ends of the joists, girders, trusses, or roof frames.

2. In mining, the long timbers that go to make up a sett in a vertical shaft, the short lengths being known as *end pieces*.

Wall Pump.—In steam engineering, a term sometimes applied to a donkey pump when bolted to a wall.

Wall Rib.—In vaulting, the *formeret* or arched rib which forms the junction between the vault and the arcade wall.

Wall Surface.—In a steam engine, the area of the walls of a cylinder exposed to the action of the working fluid; it equals $3.1416 \times \text{diameter} \times \text{stroke}$.

Wall Ties.—1. Pieces of galvanized iron laid transversely to the thickness of a wall for the purpose of binding the facing bricks to the backing. Various shapes are employed, a small square bar with V shaped ends being common, or else a strip of flat iron bent at each end over a small round rod; pieces of round wire with a loop or foot on each end, are also used.

2. Pieces of iron, brick or terra-cotta, used to bind together the two portions of a hollow wall.

Wall Washer.—In building construction, a large flat washer against which the ties of a building are screwed. Or a similar broad washer which receives the pressure of a bolthead or boltheads used for fastening brackets or plates to that face of the wall which is on the side opposite to that which takes the wall washers.

Walm.—1. To boil up.

2. A bubble in boiling.

Walnut.—The wood of the walnut tree which is often very finely marked, of from light to very dark brown color. It is strong, hard and durable, polishing well, and is used much for furniture, veneers, for making gunstocks, cabinet-work, etc.

Walrus.—A very large marine mammal of the seal family, native of the Arctic Ocean. The male has long and powerful tusks descending from the upper jaw. It uses these in procuring food and in fighting. It is hunted for its oil, ivory, and skin.

Walrus Wheel.—A polishing wheel made from the thick, specially tanned, leather of the walrus, used on work requiring the wheel to be turned up to a thin moulded edge, the leather being thick enough to allow such forms to be made from a single lap of hide.

Walschaert, Egide.—Born 1820, died 1901. A Belgian mechanic and inventor.

The opening of a railway near his home in 1835 determined his career, and he began at once to devote himself to the design of locomotive engines, showing several models that attracted considerable attention at public exhibitions, and receiving a silver medal in 1841. In 1842, he entered the shops of the state railway at Malines as a mechanic, and two years later, at the age of 24, was made chief shop superintendent at Brussels. At this time he began the study of valve motion, taking out a patent in 1844, for the new valve gear for locomotives which is known by his name. Walschaert continued for the rest of his active life as shop foreman; he constantly applied himself to locomotive improvement, and his designs were incorporated in the engines built in his shops. In 1878 he received a gold medal at the Paris Exposition, and in 1883, the Exposition at Antwerp awarded him a diploma of honor.

Walschaert's Valve Gear.—Known also as Heusinger von Waldegg's. A radial valve gear having a composite motion from a link or quadrant driven by a return crank or eccentric, and a system of levers actuated by the crosshead.

Wander.—To ramble here and there without any certain course or with no definite object in view; to range about; as, to wander over the fields.

Waney Log.—In timber, a squared log or *balk* of timber whose angles have been adzed off; a waney log is, therefore, more wasteful in the sawing up than squared logs, but its first cost is less.

Want.—1. The state of not having; the condition of being without anything; absence or scarcity of what is needed or desired; deficiency; lack; as, a want of power or knowledge for any purpose; want of food and clothing.

2. That which is needed or desired; a thing of which the loss is felt; what is not possessed, and is necessary for use.

3. In mining, a depression in coal strata, hollowed out before the subsequent deposition took place.

Warding File.—A flat, very thin file, with teeth all round it and tapering to a point; used for filing the nicks in keys to fit them to the wards in locks.

Warehouse.—A storehouse or magazine wherein are stored *wares* or commodities

of any description: a storeroom or storing department in a manufactory.

Warehouseman.—One who keeps a warehouse; the owner or keeper of a dock, warehouse or wharf store.

Warm.—1. Having heat in a moderate degree; not cold.

2. The act of warming; to raise the temperature of.

Warming Pan.—A brazier with hot coals for airing and warming a bed.

Warp.—1. In weaving, the threads which are extended lengthwise in the loom, and crossed by the woof.

2. In navigation, a rope attached at one end to an anchor, a post, or other object, employed in drawing, towing, or removing a ship or boat; a towing line; a warping hawser.

3. To turn, twist, or be twisted out of a straight direction; as, a board in seasoning or by shrinking.

Warp Beam.—In weaving, the roller on which the warp is wound in the loom, and from which it is paid out as the cloth is woven.

Warping Drum.—In navigation, a cylinder or pulley mounted on the extremities of a winch shafting, whereon to coil ropes or lines for warping the ship into her position.

Warping Frame.—In embroidery, an apparatus for drawing warp threads, laid out in sets, through the *dye beck*. Each warp is separated from the others by a pin, and is conducted *under* each lower and *over* each upper roller in succession, until delivered to the *squeezing cylinders* where the superfluous color is pressed out. Weighted levers regulate the amount of pressure on the upper cylinder.

Warping Hook.—A hook used by rope makers for hanging the yarn on, when warping into hauls for tarring.

Warping Jack.—In weaving, a contrivance suspended between the *travers* and the revolving warp frame whose duty it is to separate the warp threads into the *leas* or two alternate sets, one set for each *heald* or *heddle*. Also called the *heck box*.

Warping Mill.—In weaving, an apparatus for laying out the threads of a warp and dividing them into two sets.

Warrant.—1. A writing which authorizes officers to make arrests, searches or seizures

2. That which vouches or insures for anything; guaranty; security.

Warranty.—An engagement or undertaking, expressed or implied, that a certain fact regarding the subject of a contract is, or shall be, as it is expressly or impliedly declared or promised to be. In sales of goods by persons in possession, there is an implied warranty of title, but, as to the quality of goods, the rule of every sale is, *caveat emptor*.

Wash.—1. To clean by the aid of a liquid, usually water, accompanied by friction, with or without soap or similar detergent.

2. To surge about or move to and fro; as, water or articles water borne.

3. To subject to processes in which flowing or moving water is the agent employed, more especially with a view to separate the particles of a mass; as, to *wash* gold dust.

4. To cover with a very thin coating of some precious metal; as, gold or silver.

5. To tint with very fluid or water colors; as, in a sketch or drawing.

6. To admix clay with chalk, to reduce it into a pulp suitable for brick making. *Malm bricks* are made wholly of this compound, *washed bricks* are composed of the malm added to more clay and ground ashes, thus reducing the percentage of chalk.

Wash Back.—In brick making, an excavation, or *pan*, formerly dug in the ground, in which clay was washed to free it from flints, broken stones, etc., the material being left to settle in the wash back, the water drained off it, after which it was dug out afresh. Modern plants have substituted *circular washing pans* with revolving harrows and the like.

Washbrush.—In drawing, a draughtsman's color brush used for cleaning palettes and color utensils.

Washer.—1. A ring of metal, leather, or other material, used to relieve friction, to secure tightness of joints, or for other purposes.

2. In paper making, a cylinder or octagon of wire cloth, with internal paddles or beaters, which circulates the material operated upon in the breaking or beating engine, and pumps off by centrifugal action, the water continually flowing through the machine.

Washer Cutter.—A tool for cutting annular discs for washers, of leather, etc.

Washing Engine.—In paper making, the same as breaking engine; also termed *Hollander*, from the country of its origin.

Washing Machine.—A machine for cleansing textile fabrics and clothes by the aid of water and some detergent, usually soap. The various types in use embrace *churning*, where the articles are beaten in a tub by a pounder or revolving paddles; the *dash wheel*, as used in bleacheries, where the

materials are revolved within a drum; *slutcing*, where the hot water and suds are driven through the clothes; as, in a *bucket kler*; *squeezing* and *rubbing*, by the aid of rollers, rubbing pieces, etc. Most machines combine in themselves an arrangement of rollers or the like, for *squeezing*, *wringing* or *twisting* the fabrics, either during the washing process or immediately after it.

Wash Leather.—Chamois skin. Made from the flesh side split of sheepskin, heavily charged with lime, and then beaten in stocking mills, meanwhile being continually sprinkled with cod oil and turned repeatedly as the oil is beaten into them. After piling, so that they heat and oxidize the oil, the excess of oil is pressed out, the skins are washed in an alkaline solution, bleached to the proper yellow color, and trimmed; the surface is finally prepared by buffing on an emery wheel.

Wash Mill.—A circular pit or pan in which materials are disintegrated or converted into a pulp by means of harrows or blades depending from revolving arms, which radiate from a central vertical shaft. Such mills are used to purify clay from stones, etc., in brick making or cement manufacture; also for treating chalk and limestone for the same purposes. The clay or chalk flows off with the water in the form of pulp, the stones, etc., being precipitated to the bottom, whence they are removed at intervals. The harrows trail over the gathered stones, where fixed blades would entangle with them and break.

Washout.—The washing out or away of earth, etc., especially of a portion of the bed of a road or railroad by a fall of rain or a freshet.

Washout Plug.—A screw plug fitted in various positions on the shell of a boiler, to drain off water or to introduce the nozzle of a hose for washing out scale, mud, etc.

Wash Plates.—Plates or diaphragms fitted in the upper portion of a boiler to prevent the water from surging about, and hence, being carried over with the steam.

Wastage.—Loss by use, decay; evaporation, leakage or the like; waste.

Waste.—1. To wear away by degrees; to impair gradually; to diminish by constant loss; to use up; to consume; to wear out.

2. In coal mining, culm; coal dirt; the fine coal made in mining and in preparing the coal for market; in metal mining, dross; refuse ore; impoverished veinstone.

3. Surplus, soiled or dirty water; the discharge of overflow from tank cisterns, etc.; soil or refuse; sewage.

Waste Channel.—In hydraulics, a spill-way or channel whereby flood water

from a dam or intake, or the surplus water from a waste weir, is conducted to a lower watercourse, or to the tail race.

Waste Cock.—A cock fitted to certain types of injector, whereby steam may be blown back into the suction pipe and tender, to thaw the water in cold weather; and other similar uses.

Waste Gases.—In blast furnaces, the gaseous products of combustion, chiefly carbonic oxide, carbon dioxide, and marsh gas mixed with inert nitrogen. Metallurgists now aim at utilizing the combustible gases as much as possible. Hence the use of close topped blast furnaces, and of regenerative furnaces, by which the greater portion of the heat is utilized instead of being dissipated into the atmosphere.

Waste Heat.—In smelting furnaces, the heat of the waste gases which have been led down from the cone, which closes the mouth of the blast furnace.

Waste Mould.—In founding, a prepared trough in the foundry floor, into which is run whatever metal remains in the cupola after casting.

Waste Pipe.—1. An exhaust pipe from a non-condensing engine.

2. A safety valve escape pipe to the atmosphere.

Waster.—In machine shop practice, a bad casting; an article spoiled by accident or defective workmanship.

Waste Weir.—In water reservoirs, a weir constructed at one side of the impounding dam, for carrying off any surplus waters that may accumulate from the springs or other source of supply.

Watch.—1. To maintain a lookout, or to remain in a position of observation.

2. The length of time a person is on duty. At sea, the watches are usually of four hours each; the afternoon watch, noon to four p. m.; first dog watch, 4 to 6 p. m.; second dog watch, 6 to 8 p. m.; first watch, 8 p. m. to midnight; middle watch, midnight to 4 a. m.; morning watch, 4 to 8 a. m.; forenoon watch, 8 a. m. to noon. The dog watches provide for a shift of duty for sailors and quartermasters, who are usually watch and watch, that is, four hours on and four hours off; the name is a corruption of *dodge*; as the routine is dodged thereby, Engine room crews usually work four hours, succeeded by eight off duty, the watches being shifted at various parts of the voyage.

3. In navigation, a number of seamen and officers who are on duty together at the same time.

4. A pocket timekeeping machine, which automatically records the number of vibrations made by a *balance* and *spring*, which take the place of the pendulum in large clocks. The motive power consists of a coiled *spring*, which drives a *train* of wheels and pinions, moving at different speeds so as to show the different intervals of time. The train is periodically and frequently arrested in its motion by the *escapement*, which checks the tendency of the driving spring towards acceleration. The movement of the escapement is controlled in turn by the *balance* and its *hair spring*; the former is a little fly wheel, and the release of the teeth of the escapement is dependent entirely upon the beat of the wheel. At the same time, the escapement restores to the balance the energy which it has dissipated in checking the motion of the train. The *regulator* lengthens or shortens the hair spring, thus varying the vibration of the balance wheel.

Watch Jewel.—A diamond, sapphire, ruby, chrysolite, aqua marine, or garnet, used for the pivot hole of a watch, to reduce friction and wear.

Watchmaker's Wiper.—From the earliest times in the history of watchmaking it has been the custom of watchmakers to reduce fresh bread to the form of dough. This is done by steaming and kneading. They then use this dough for removing oil and chips that naturally adhere, in the course of manufacture, to pieces as small as a part of a watch. The oil is absorbed by this dough, and the chips stick to it, and there is no other known substance which can be used as a wiper without leaving some of its particles attached to the thing wiped.

Watchman.—One set to watch; a person who keeps guard.

Watchman's Time Detector.—An instrument carried by a watchman who visits the various places on his beat where the keys are within reach. Six keys are shown for as many watchmen, and when inserted in the watch will prick a hole at a point opposite to the hour at which the visit is made, and each man's record in his own row.

Watch Tank.—In marine service, a small tank subdivided into three compartments, containing the daily allowance of oil for each watch.

Watchword.—A countersign; a password. A sentiment or motto given to obtain admission to secret meetings; as, to a trade union assembly.

Water.—A colorless transparent liquid composed of the two gases, hydrogen and oxygen. It freezes at 32° Fahr., or 0° C., and boils at 212° Fahr., or 100° C. The following general laws governing the action and state of water are important: (a) Water is practically non-elastic, experiment appears to show that for each atmosphere of pressure (14½ lbs.) it is condensed 47½ millionths of its bulk; (b) water at rest presses equally in all directions; (c) a

given pressure or blow impressed on any portion of a mass of water confined in a vessel is distributed equally through all parts of the mass; (d) the surface of water at rest is horizontal; (e) the pressure on any particle of water is proportioned to its depth below the surface; (f) water rises to the same level in the opposite arms of a recurved tube; (g) any quantity of water, however small, may be made to balance any quantity however great.

Water Arch.—1. In a steam boiler, a chamber of plates or of pipes within a furnace, replacing the ordinary fire brick bridge or arch, or the deflecting arch over the firedoor of externally fired boilers. The same as *water table*.

2. A locomotive fire box arch, which is suspended by tubes, which add to the heating surface and promote circulation.

Water Ballast.—In sailing or steam vessels, water carried in subdivided tanks in the double bottom or elsewhere to act as stiffening, and give stability to a vessel; it is easily handled by pumping, and replaces the earth and stones formerly carried for the same purpose.

Water Bar.—A tube serving as a fire bar in a water grate.

Water Bellows.—An old form of blowing machine, in which two inverted bell-like vessels, one at either end of a beam, were alternately raised or lowered into a chamber containing water. A suction and a delivery pipe, each with proper valves, came up through the water into the cavity of each bell. The air was thus aspirated and expelled by the oscillation of the beam, the water seal preventing its escape.

Water Bosh.—A metallic basin in a puddling or boiling furnace, which is made double, so that water may circulate there through, to protect the furnace from the destructive action of heat and cinder.

Water Brake.—An arrangement of the Le Chatelier brake, in which water is admitted to the cylinders of a locomotive, and pumped by the pistons through pipes and cataract valves. This is used on long and heavy descending grades to check the speed of the train.

Water Bridge.—In some types of boiler, the fire box arch is superseded by a hollow wall or bridge containing water, which thus becomes an integral part of the boiler.

Water Chamber.—In gas engines, a chamber, usually annular in form, encircling the cylinders of gas engines and air compressors, to prevent the heating

due to the production of combustion in the first place, and to the compression of the air in the second.

Water Check.—A check valve, belonging to certain types of injectors, to regulate the supply of water.

Water Column.—In hydraulics, a column which receives the supply water for a hydraulic crane. It is of cast iron, and encloses within its body the actual supply pipes.

Water Cooled.—Gas and gasoline engines are said to be *water cooled* when a water jacket surrounds the cylinders, to carry off the heat of combustion, which, if unchecked would volatilize the lubricant. The circulation is maintained either by a pump or by thermo-syphonic action. Small automobile engines are frequently *air cooled*.

Watercourse.—A channel, usually natural, through which a stream of water flows.

Water Crane.—On a railway, a hollow pillar, provided with a swiveling cross arm at the top, which has a hose at one end, and a balance at the other, for supplying locomotives with water at a distance from the tank.

Water Elevator.—1. Any mechanism for raising water, especially to a considerable height above ground; as, a windmill operating a pump.

2. An elevator or lift operated by hydraulic power.

3. A vertical or inclined conveyer whose buckets dip up water from a source of supply and deliver it into a conduit or elevated receptacle, thus fulfilling the functions of a pump. Under the name of chain pumps, they are much used in smaller sizes.

Waterfalls.—The sudden dropping of a stream or river from a higher level to a lower; as, the Falls of Niagara. When the water makes a sudden abrupt leap or series of leaps, it is known as a *cascade*; where the fall is considerably broken, it is termed a *cataract*.

Waterfloat.—A device in a cistern, boiler, tank, etc., which, floating on the water, actuates a valve.

Water Flush.—A system of well boring, in which percussive drills are used in connection with water forced down to the bottom of the hole through the drill rods. This water jet makes the tools cut better

and washes the detritus up out of the hole. Its great objections are, the great probability of waterlogging the surrounding territory, and the pressure of water forcing back bodies of oil that have only a small force behind them, thus leading to the passing by of possibly valuable oil-bearing territory.

Water Frame.—In spinning, the original spinning machine invented by Arkwright, which was driven by water-power.

Water Gas.—1. An æriiform mixture used for lighting, or as fuel.

2. Gas made in an intermittent process, by blowing up the fuel bed in a producer to a high state of incandescence, and then shutting off the blast, forcing steam through the fuel instead; air and steam are thus alternated in the same generator. The heat of the producer decomposes the steam into oxygen and hydrogen, the former combining with the carbon of the fuel to form carbon monoxide, the latter remaining liberated. Economy is promoted by burning the gas first produced in "blowing up," within firebrick regenerators which heat the incoming air blast. At other times, this gas forms a *lean producer gas* and is mixed with the rest. To increase the illuminating power of the water gas, petroleum is injected into the producer beyond the fire, and is there volatilized into fixed gas, the product thus consisting of hydrogen, volatile hydrocarbons, and carbon monoxide. It is the latter which constitutes the danger of this gas. Water gas is best made in conjunction with ordinary coal gas, as the coke from the latter can be consumed in the producers, thus doubling the supply.

Water Gauge.—A boiler fitting used to indicate the height of the water within a boiler. It consists of a glass tube connected with the boiler by brass elbow seatings, at such an elevation that the lower and upper ends of the tube will be the lowest and highest permissible water levels.

Water Glass.—Soluble glass, used as a protective coating for various objects.

Water Grate.—When, as in certain steam boilers, to increase the heating surface, hollow water tubes are used for grate bars, the arrangement is termed a *water grate*.

Water Hammer.—A noise resembling the blows of a hammer, caused by the pulsative action of entrained water within a steam pipe. It is very dangerous, pipes being ruptured at bends, etc., by the force of previously condensed water driven against them when steam is admitted.

Water Hardening.—In blacksmithing, the hardening of steel, effected in water as opposed to oil hardening. In water

hardening, the steel becomes more brittle and acquires a harder texture than when oil is used.

Water Heater.—A perforated nozzle designed to heat the water within a vessel by blowing steam into it. The interior of the nozzle and its perforations are so arranged as to minimize the noise of ebullition.

Watering.—1. In textile manufacture, a process of giving a wave like appearance to fabrics, by passing them between metallic rollers variously engraved, which, bearing unequally upon the stuff, renders the surface unequal, so as to reflect the light differently. *Watered silk* is said to have been invented at Lyons in the seventeenth century.

2. A daily sprinkling of concrete building blocks, for a period of from eight to ten days after the blocks have been taken out of their forms.

3. The sprinkling of a macadamized road under construction, previous to the rolling down process of the top finish.

Watering Can.—In a foundry, one with a *rose*; the usual form employed by gardeners. It is used by moulders to keep the sand of the right degree of moisture.

Water Jacket.—A casing placed about anything exposed to heat, as a tuyere, to permit a current of water to flow around it and keep it cool.

Water Laid.—In paper making, a series of lines, letters or designs, in the body of paper, often adopted by a manufacturer to indicate his own make; sometimes called *cable laid* and *watermark*.

Water Leg.—A narrow, more or less vertical chamber in which water is confined, as in the space between the internal and external fire boxes of a locomotive type of steam boiler. Also applied to the similar spaces within the tender tank where it surrounds the fuel compartment.

Water Level.—1. The level formed by the surface of still water.

2. A leveling instrument in which water is employed (commonly in a trough or curved tube) for determining the horizontal line.

3. The height at which the water stands in a boiler.

Water Lines.—1. In shipbuilding, a ship's lines drawn parallel with the surface of the water, at varying heights. In the *sheer* plan, they are straight and horizontal; in the *half-breadth* plan, they show the form of the ship at the successive heights marked by the water lines in the sheer plan.

2. In navigation, the line up to which the hull of a vessel is submerged in the water; as, the *Pimsoll line*.

Watermark.—1. A mark indicating the height to which water has risen, or at which it has stood.

2. A letter, device, etc., wrought into paper during the process of manufacture.

Water Meter.—1. A contrivance for measuring the supply of water; as, from a street main.

2. An instrument to determine the amount of water evaporated in a given time; as, from a steamship during a voyage.

3. An apparatus for determining the flow of water along a pipe, usually from the mains to an individual consumer. Various types are in use: *positive meters*, which measure the whole of the flow, and are naturally suitable for small quantities only; *comparative meters*, which measure a part of the flow alone, the remainder being deduced by comparison; *inferential meters*, in which the velocity of flow alone is ascertained, the total discharge being inferred therefrom in connection with the size of the conduit.

Water Packer.—A device intended to cut off water from the lower levels of an oil well, or to separate two distinct flows of oil from different strata; more especially in fountaining wells. It consists essentially of two tubes sliding within one another, the inner tube being swathed with rubber rings or with canvas and rope yarn, for some length between its own upper socket and the socket on top of the larger tube. The whole is lowered into the well, on the tubing, until the perforated anchor pipe, connected with the outer tube, rests on the bottom. The whole weight of the string of tubing then rests upon the inner tube of the packer, compressing the packing outward against the casing of the well, so that the upper strata are cut off from communication with the lower.

Water Pillar.—In railway service, a hollow standard and overhung arm for supplying a tender with water. Also known as a *water crane* from its form. It has a revolving swan neck, and the valve is operated by a hand wheel, rod and miter gear.

Water Power.—The power of water employed to move machinery; a fall of water which may be used to drive machinery; a source of power from water.

Water Pressure Engines.—In hydraulics, these include generally hydraulic rams, turbines, and other motors driven by water pressure, but refer especially to certain types of engines, having cylinders and pistons, either reciprocating or rotary, whose construction is the same in principle, though differing in detail, as that of steam engines, the pressure due to a head of water being employed instead of steam.

Water Pressure Pump.—In hydraulics, a machine for using the pressure of a

body of water to raise a smaller quantity to a greater elevation; as, to the upper stories of houses where the pressure in the water mains and regular service is not sufficient.

Waterproof Glue.—One largely used in shipbuilding; a waterproof cement, for making of which the following is the recipe:

Dissolve one ounce of gum sandarac and one ounce of mastic in a half pint of alcohol, and add one ounce of clear turpentine. At the same time, a very thick glue is to be prepared and added to the first mentioned solution both of them heated almost to the boiling point, and stirred together thoroughly. It is then to be strained through a cloth, when it will be ready for use. This glue is to be applied hot.

Waterproofing.—1. The chemical treatment of porous materials, making them impervious to water.

2. The art of coating textile materials with a solution of caoutchouc in coal-tar naphtha, the solvent afterwards evaporating and leaving a thin film of rubber on the fabric.

3. Paper, cloth, wood, etc., are rendered impermeable to water and capable of resisting the action of acids, by coating with paraffin wax. The material is immersed in a solution of paraffin wax in pure benzine, for a period calculated to secure the required penetration or saturation; the solvent evaporates on drying, leaving the paraffin in the pores.

4. Coating materials with varnish, water-glass, or the like.

Water Ram.—A hydraulic ram, whereby a considerable body of water with a slight fall is made to force a small amount to a greater elevation.

Water Rate.—In water works, a rate or tax for a supply of water, the quantity being determined generally by a meter.

Water Retting.—In linen manufacture, the process of *retting*, or rotting, flax or hemp by steeping in water, to soften the mucilage which binds together the fibrous and cellular portions of the plant.

Water Scoop.—In railway operation, the hinged lower end of the tender pipe which is lowered into the *water trough* to pick up water while the locomotive is running.

Water Screw.—In hydraulics, a water elevator on the principle of the *Archimedeian screw*. It consists of an inclined axis with a spiral projection, rotating in a cylinder whose lower end is submerged; there is, however, a loss of water between the thread of the screw and the casing.

Water Service.—In a steamship, a system of piping in the engine room and

supplied from the sea, by means of which cold water is circulated through or allowed to drip on a bearing, if necessary, to dispel the heat of friction.

Watershed.—The high land or water-parting between two river basins or seas. Water flows from one side of the watershed, or divide, into one river system, from the other slope into another basin.

Water Space.—The part of the steam boiler which contains water; this is usually about $\frac{3}{4}$ of the whole cubical contents.

Water Spout.—1. A moving column of spray and mist, with considerable masses of water in the lower parts. A remarkable meteorological phenomenon, of the nature of a tornado or whirlwind, usually observed over the sea, but sometimes over the land.

2. A pipe for the free discharge of water; as, one connecting with the gutters of a roof; any spout, tube or nozzle, from which water flows or is ejected.

Water Supply.—An accumulated store of water in reservoirs, also the water in the main pipes for distribution for a city water system.

Water Swivel.—In well boring, a combined universal joint and hose coupling, forming the connection between the water supply pipe and the drill rods, and permitting complete rotation of the tools.

Water Table.—1. In building, a projection, with sloping edges, to throw rain water off a buttress.

2. In engineering, a bridge or arch, within a furnace, which is made of the same material as the boiler and filled with water, thus constituting part of the heating surface.

Water Tank.—An elevated reservoir for supplying locomotives with water, provided with pumping engines to supply it from a well or stream, and heating apparatus to prevent freezing in winter.

Water Tight Compartment.—A portion of a ship divided off by water tight bulkheads or partitions extending from the lower to the upper extremity of the vessel.

Water Tight Door.—A door through a water tight bulkhead. It is solidly constructed of metal and fits against an elastic joint; below the water lines all water tight doors work vertically in

wedge shaped channels, and must be controllable from above the water line.

Water Tower.—An elevated structure supporting or enclosing a large water tank, for the purpose of securing a high pressure supply, either for fire extinguishing or for general purposes.

Water Troughs.—In railway operation, channels or conduits laid between the rails, into which scoops dip from the tender, and pick up water while the train is in motion. The scoop is lowered by the fireman, the end of the trough being tapered to automatically lift the scoop.

Water Tube Boiler.—This term is applied to a class of boilers in which the water is contained in a series of tubes, of comparatively small diameter, which communicate with each other and with a common steam chamber. The flames and hot gases circulate between the tubes and are usually guided by partitions so as to act equally on all portions of the tubes. There are many varieties of this type of boiler.

Water Twist.—Cotton yarn spun on a water frame.

Waterway.—In shipbuilding, a *strake* on the inside of the vessel above the ends of the beams. It is bolted downward through the *beam* and *shelf*, and is bolted, laterally, through the *futtock* and planking. It is also secured by a fore and aft dowel to the beam. It forms a channel to lead the water to the scuppers. In iron vessels it assumes many different forms, according to the judgment of the builders.

Water Wheel.—1. A wheel driven by water power, through floats or buckets set around its circumference, the water operating usually by gravity alone, although in some patterns the velocity is utilized. Wheels are classified as *overshot*, *breastshot*, or *undershot*, according to where the water comes into contact with the circumference of the wheel.

2. A water motor of any sort: a *turbine*.

Water Works.—An installation comprising reservoirs, filter beds, and pumping engines, for dealing with water supply, especially of a city.

Wattle.—A fence, panel, screen, or wall, made of withes interlaced with stakes.

Wave.—1. An undulation.

2. An advancing ridge or swell on the surface of a liquid, resulting from the oscillatory motion of the particles composing it, when disturbed from their position of rest by any force.

Waved Wheel.—The edge of the wheel is waved or convoluted, so that as it

revolves it imparts a lateral oscillation to an arm, pitman, or what not. An anti-friction roller at the end of the arm traverses the face of the wheel, following its prominences and depressions.

Wave Power.—That which resides in the advancing undulations, or the rising curves and edges of waves as they come with great volume upon the land; as, in a flood, or tide.

Wave Resistance.—The resistance to a ship's passage occasioned by waves, either through weather encountered, or generated by the hull itself.

Wave Trap.—In hydraulic engineering, a widening inward of the sides of piers, to afford space for storm waves which roll in at the entrance, to spread and extend themselves.

Wax.—A fatty, solid substance, secreted by bees. Also some vegetable exudations, resembling true wax in qualities or appearance.

Waxed End.—A shoemaker's sewing thread with a bristle ingeniously fastened at the end, to enable it to lead through the hole made by the awl.

Waxed Paper.—Paper impregnated with paraffin wax, in which steel articles, etc., are wrapped to prevent them from rusting.

Waxing.—1. In leather manufacture, the process of finishing leather which has been *shaved*, daubed, grained, bruised and whitened. It consists of treating with *blacking*, composed of oil, lampblack and tallow, or *black size*, composed of stiff size and tallow, and subsequent treatment with a slicker.

2. The treatment of thread with soft wax in the sewing machine for boots and shoes.

3. The process of stopping out colors in calico printing.

Waybill.—A list of passengers in a public vehicle, or of the baggage or goods transported by a common carrier, on a land route. When the goods are transported by water, the list is called a *bill of lading*.

Way Gate.—In hydraulics, the tail race of a mill; as, of a grinding (water) plaster mill.

Ways.—1. Balks or skids, for rolling up weights or for sliding them down; greatly used in transportation.

2. The upper structure of pile driving machinery, wherein the hammer runs up and down.

3. The guides in which the counterbalance weights of elevators run up and down.

4. In machinery, the longitudinal guides or guiding on the bed of a planer, lathe or the like, along which a table or carriage moves.

5. That by, upon, or along which one passes or progresses; opportunity or room to pass; place of passing; passage, street, track, or path of any kind; as, they build a way to the power house.

6. The inclined timber sills upon which a ship is built and upon which she slides into the water when launched.

7. The rails of a ship railway, slip or slipway, up which is drawn the cradle on which the vessel rests.

Weak.—1. Wanting strength; not able to sustain a great weight, pressure, or strain; as, a weak timber, a weak rope.

2. Not firmly united or adhesive; easily broken or separated into pieces; not compact; as, a weak ship; not stiff; as, the *weak* mast of a derrick.

Wear.—1. The diminution or lessening of substance occasioned by the use of anything, principally through the slow mutual abrasion of pieces in frictional contact with each other. Machinery parts which are subject to wear are generally provided with means for adjustment, so as to take up the slackness produced.

2. To bring a ship round with the head *away* from the wind, the reverse operation from *about ship*, which brings the ship up into the wind to turn.

Wear and Tear.—To endure or suffer use; to last under employment; to bear the consequences of use; as, waste, consumption or attrition.

Wear Ship.—To put a vessel on another tack by turning her head away from the wind; to *go about by jibing*.

Weather.—1. The atmospheric conditions prevailing at any specified time, or those prevailing during any particular period as shown by meteorological observations and records.

2. In physics, to be subjected to the influences of atmospheric conditions; as, the abrasive action of rainfall, the disintegration due to frost, the deteriorating influence of oxygen and other gases contained in the atmosphere, etc. The weather thus acts upon rocks, pigments, and most materials.

Weather Boarding.—1. A facing of thin boards tapering to a sharp or feather edge on one side, resembling clapboards, lapped over one another to form a protection for the sides of wooden buildings.

2. A sort of skirting around the outer walls of wooden buildings, just at the ground level, extending upwards for a few feet.

Weathercock.—In building, a vane turned by the wind to show the direction thereof.

Weatherglass.—In navigation, an instrument for indicating coming changes in the weather.

Weathering.—The action of the elements, or weather; the action of heat, cold, frost, wind or rain, on rocks, minerals, etc., changing their color and composition, wearing away sharp edges, and gradually disintegrating them.

Weather Strip.—In carpentry, a pliable piece of rubber, for instance, which closes accurately the space between the shut door and the threshold, or a jointed piece which lifts clear when the door is opened, and shuts tightly down when the door is closed.

Weather Tiling.—Vertical tiling suspended from the face of walls to protect them.

Weaving.—The act or process of combining and interlacing two sets of threads at right angles to each other, forming a textile fabric. One set or series of threads, the *warp*, is stretched more or less tightly in the *loom*, and the other threads, *woof*, *weft* or *filling*, are passed, by means of the *shuttle*, alternately over and under the warp threads, which are raised or depressed for the purpose, by means of the *heddles* or *healds*. At each pick of weft passed by the shuttle, the threads are driven or beaten close together by the swinging action of the *slay* or *lathe*. The various patterns, woven into fabric, are formed by the manipulation of the warp threads, and by the employment of various colored wefts.

Web.—1. Woven fabric.

2. The plate, or its equivalent, in a beam or girder which connects the upper and lower flat plates or laterally existing portions; the corresponding portion, between the tread and foot of a railway rail; that portion of a car wheel which extends between the *hub* and the rim.

3. The blade of a saw.

4. That portion of an ordinary anvil which is of reduced size below the head, and from which the divergent horns proceed.

5. The arm of a crank of a steam engine, when flat and thin.

6. The *bit* of a key, consisting of the web and the wards; the latter are the slots which are traversed by the wards of the lock, as the key turns.

7. In paper making, the term applied to the continuous sheet of half dry paper after it has been taken from the wire cloth by the couch rolls.

Webbing Pliers.—A form of pliers with winged or extended toothed jaws, so made as to grip a wide surface of webbing; as used by saddlers, upholsterers, etc.

Web Frames.—In shipbuilding, deep frames introduced into a ship at intervals to replace hold beams; they are girders built of plates and angle bars.

Web Gear.—In machinery, a toothed wheel which is formed as a plain disc, instead of having its rim supported from the hub by means of spokes or arms.

Web Press.—In printing, a press which takes paper from a roll instead of being fed with sheets. A modern quintuple Hoe web press will print 300,000 twelve page newspapers in an hour.

Web System.—In construction, the system of braces connecting the flanges of a lattice girder, post, or the like.

Wedding Knot.—In rigging, a tie for uniting the looped ends of two ropes.

Wedge.—A pair of inclined planes, united by their bases, or back to back. If, instead of moving a load on an inclined plane, the plane itself is moved beneath the load, it then becomes a wedge. All cutting and piercing instruments, such as knives, razors, scissors, chisels, nails, pins, needles, etc., are wedges.

Wedging.—In carpentry, the insertion of triangular pieces at the sides of a tenon in a mortise, to hold it firmly in place.

Weep Hole.—A small hole left for drainage through the masonry of a retaining wall, or of a bridge abutment, etc.

Weft.—The *woof* of cloth; the threads that cross the *warp* from selvage to selvage; a web; a thing woven.

Weft Fork.—In weaving, a stop motion device, consisting of a weighted fork suspended by the weft thread or woof, so that, if the thread breaks, the fork falls and shuts off the power from the machine.

Weft Hook.—In weaving, one for drawing in the *filling* in the case of slat weaving looms.

Weigh Beam.—Adapted for cotton bales or barrels, but by suspending a suitable *cradle*, pig iron, hams, or any other merchandise may be weighed.

Weigh Bridge.—A platform connected with a system of balance levers, whereby the weight of anything placed on it

is readily ascertained, by moving small weights along a steelyard.

Weighing.—1. The act of determining weight.

2. In foundry work, the application of weights, etc., to the cope or upper box, to prevent its being lifted by the flowing metal while pouring.

Weighing Machine.—Any large apparatus for weighing; especially, platform scales, arranged for weighing heavy bodies; as, wagons with their loads, and the like.

Weighing Scale.—A contrivance for ascertaining the weight of an object, also called *balance dynamometer*

Weigh Lock.—A lock, as, on a canal, at which boats are weighed and their tonnage is settled.

Weigh Shaft.—In steam engineering, the rocking shaft used in working the slide valves by the eccentric.

Weight.—1. The quality of being heavy; gravity, that property of bodies by which they tend toward the center of the earth. Weight differs from gravity in being the effect of gravity, or the downward pressure of a body under the influence of gravity; hence, it constitutes a measure of the force of gravity, and, being the resultant of all the forces exerted by gravity upon the different particles of the body, it is proportional to the quantity of matter in the body.

2. A standard measure for ascertaining the weight of any material, by means of a balance or scales. The weights are usually made of brass in the smaller sizes and cast iron in the larger. They are adjusted to correct standards by boring holes into their bases.

3. To fill the interstices of a fibrous material; such as, cloth, cotton goods, or paper with mineral matter, for the purpose of imparting stiffness and weight, also to give a smooth surface.

Weighting.—In a foundry, when the flasks in which a mould has been made cannot be held together by cotters, or clamps alone, the top part has to be held down by *weights placed upon it*, so as to enable it to resist the upward pressure of the metal. Every four inches perpendicular height of liquid cast iron exercises a pressure of one pound on the square inch, and when high gates are used, considerable force is necessary to hold the box together.

Weight Nail.—In navigation, a nail heavier than a deck nail, and used for fastening buttons, cleats, etc.

Weight of Coal.—The weight of coal in the solid lump is from 70 to 80 pounds per cubic foot for bituminous grades,

and from 85 or 90 to 100 pounds per cubic foot for anthracite grades. When broken up in ordinary commercial sizes, however, its weight, *in bulk*, is usually from 50 to 54 pounds per cubic foot for bituminous, and from 53 to 58 pounds per cubic foot, for anthracite. These weights correspond to an allowance of from 42 to 45 cubic feet per ton of 2,240 pounds for bituminous grades, and from 39 to 42 cubic feet per ton for anthracite grades. In estimating the capacity of coal bunkers, the above figures are usually taken, varied however, by the size of the lumps of coal.

Weir.—A wall or dam across a stream, over the top of which the escaping water flows. The object of placing a weir may be for raising the level or for affording a means of measuring the quantity which passes; in the first case, the impounded water may be led to a mill, a sluice or a fish trap; in the second, the mean depth of water flowing over the weir is carefully gauged, and its speed noted by continuous observations. For measuring small streams, a *notched board* is employed, and under the name of *tumbling bay*, its use is very common.

Weld.—To press or beat into intimate and permanent union; as, two pieces of iron or steel when heated almost to fusion.

Weldable.—A term applied to material; as iron, if it can be united, when hot, by hammering or pressing together the heated parts. The nearer the properties of the material, after being welded, are to what they were before being heated and welded, the more *weldable* it is.

Welding.—The art or process of incorporating two pieces of wrought metal together while at a white heat, when they are in a plastic or semi-fused condition. The pieces to be welded are *scarfed*, formed into a *bird's mouth*, or else simply *upset* and *butted* together. Large pieces may be *glut-welded* by the addition of stick-pieces on either side of the joint. A variety of fluxes are used, to preserve the metal from forming a film of oxide or to clean the surfaces; of these borax is probably the best.

Welding Heat.—In blacksmithing, the degree of heat when in smith's work the iron or steel gives out vivid sparks, and small globules melt off. It corresponds roughly with a temperature of from 2500° F. to 2700° F., for wrought iron, but less for steel, which requires special care as regards the temperature, cast steel being difficult of welding and scarcely bearing more than a cherry red. Shear steel will weld easily, and endure a white heat safely, so that in welding, the judgment and experience of the smith is of first importance.

Welding Swage.—A block or fulling tool for assisting the closure of a welded joint. An appliance used by blacksmiths.

Well.—1. In architecture, a deep cavity within a building occupied by a stair-

way, an elevator, or designed for lighting the several stories from above.

2. A pit or hole sunk into the earth to such a depth as to reach a supply of water, generally of a cylindrical form, and walled with stone or bricks to prevent the earth from caving in.

3. In sea language: (a) An enclosure in the middle of a ship's hold, around the pumps, from the bottom to the lower deck, to preserve them from damage; (b) an apartment in the middle of the hold of a fishing vessel, made tight at the sides, but having holes perforated in the bottom to let in fresh water for the preservation of fish while they are transported to market; (c) a vertical passage in the stern into which an auxiliary screw propeller may be drawn up out of water.

4. A sump or sink into which bilge or other water can drain, on shipboard, to facilitate pumping.

Well Crane.—In rigging, a fixed post crane, one half of whose post is above ground and the other sunk in a pit, or well dug to receive it, and encased with masonry, or with iron plates. The lower end of the post rests on a step at the bottom of the well and the fulcrum of the post is at the ground line.

Well Deck.—In navigation, a type of steamer in which the space of deck between the forecabin and bridge forms a well.

Well Head.—In hydraulics, the arrangement at the top of the casing of a well. Various types are provided to accommodate the nature of the discharge, whether pumped, fountaining or operated by an air lift. Also called *casing head*.

Well Stage.—In mining and excavating, a framing of timber erected over the mouth or in the mouth of a well or shaft to carry the pumps and pipe connections.

Welt.—1. The strip of iron or steel laid over a butt joint; a butt strap.

2. In shoemaking, a strip of leather laid around a shoe between the sole and the upper.

Welt Strap.—A butt strap or covering plate for a riveted joint; as, in the joints of leather or rubber belts.

West.—The point in the heavens where the sun is seen to set at the equinox, or, the corresponding point on the earth; that one of the four cardinal points of the compass which is in a direction at right angles to that of north and south, and on the left hand side of a person facing north; the point directly opposite to east.

Westinghouse, George.—Born 1846.

An American inventor, engineer and manufacturer. He built a rotary engine when he was only 15 years old. His first notable invention was a railroad frog (1865), but the same year, a collision of freight trains near Troy, N. Y., drew his attention to the matter of power brakes. Experimenting at first with steam unsuccessfully, he turned to the investigation of the possibilities of compressed air, which was just coming into use in Europe for tunneling purposes. The result of his efforts was the invention of the air brake (1868), which at once proved its great efficiency. In 1869 the Westinghouse Air Brake Co. was formed. Many important improvements in the brake followed, of which the triple valve device was almost as important as the original invention. Mr. Westinghouse next turned to the subject of railway signaling, patenting, in 1883, the system now manufactured by the Union Switch and Signal Co., of Pittsburg, Pa. In 1886 the Westinghouse Electric Co. was organized which made rapid advances in the manufacture of electrical apparatus and machinery, largely invented and developed in its own shops.

Westinghouse Brake.—An automatic continuous brake, in which the power to apply the brakes is derived from compressed air stored in *reservoirs* under each vehicle. A continuous *train pipe* affords means of control, as the valves of the mechanism are so arranged that reduction of pressure in this pipe, which can be effected by opening valves at either end, or automatically by rupture, will cause the compressed air in the before mentioned reservoirs to press on the piston of the brake cylinder, and, through the rigging, on the *brake shoes*. A direct acting steam pump on the locomotive compresses the air to eighty or one hundred pounds per square inch, charging the reservoirs and train pipe, so that, when both are in equilibrium, the brake is released.

Westward.—Lying toward the west; tending westward.

Wet Compression.—In ammonia refrigeration, a small amount of liquid ammonia injected into the suction pipe or return from the refrigerator, just sufficient in quantity to absorb the superheat of compression by its evaporation.

Wet Dock.—An enclosed dock within which ships remain afloat all the time, as distinguished from a *dry* or graving dock.

Wet Felt.—In paper making, an endless band of felt to which the paper web is fed by the couch rolls, and passes it through the first press rolls. The web is then transferred to the *press felt* which is running in the reverse direction and carries it through the second press rolls, so that the side which had laid on the wet felt may also be subjected to pressure. The wet felt becomes covered with size, etc., and is freed by passing through a trough of water and beating with revolving knives; the *press felt* is occasionally removed from the machine and cleansed by hand or power.

Wet Lime Purifiers.—In gas making, purifying chambers, fitted with trays or sieves containing moist lime, which absorbs the carbon dioxide and sulphureted hydrogen from the gas, forming calcium carbonate and calcium sulphide, thus producing valuable fertilizers while removing deleterious constituents from the coal gas.

Wet Meter.—An instrument for measuring the quantity of gas. The unit of quantity for gas is the *cubic foot*.

Wet Steam.—Steam as delivered from a mass of water, and holding water in suspension mechanically.

Wet Wood.—Timber which has not been seasoned properly and which, therefore, retains the sap in the vessels. Timber which has been seasoned may become wet by long exposure to the weather. This moisture soon dries, however, under cover and is not so detrimental as the *sap wet*.

Whaleback.—In navigation, a type of cargo steamer peculiar to the Great Lakes, in which the hull is of a rounded section, having no *hatch coamings* but ways, simply closed by plates, thus affording no erection for seas to break against and permitting the water at once to escape. A gangway, fore and aft, serves as a weather deck, and access to the machinery and 'tween decks is gained through turrets at either end.

Whale Boat.—A large boat with both ends pointed, and generally steered by an oar, as used in whale fishing.

Whalebone.—The baleen blades of the right or Greenland whale, an average of 1700 lbs. being taken from each "fish." The whalebone is a series of slips of black fiber, fine and highly elastic in texture, fraying out at the inner edge and point into long soft hairs. The longest pieces may be ten feet or more, weighing five to six pounds. The use of this fringe of blades, some six hundred in number, is to strain the water from the minute crustaceans upon which the whale feeds, it simply letting them swim into its mouth, and expelling the water through its nostrils, the food being retained by the *baleen*.

Whale Oil.—A lubricating oil obtained principally from the fat or blubber of the Greenland or *right* whale. It is largely used for oiling wools during combing, in batching flax and other fibers, in currying and in dressing chamois leathers. The average right whale produces about fifteen tons of oil, but the oil of commerce may be obtained from the blubber of any whale or dolphin. Also known as *train oil*.

Whang.—Tough leather adapted for strings, thongs, belt laces. It is commonly of calf skin.

Wharf.—A landing place, usually parallel with the waterway, at which cargoes may be discharged or taken in. The structure may resemble a wooden or iron pier, or may be an embankment retained and protected by sheet piling. A wharf, when built of or faced with masonry, is usually termed a *quay*.

Wharf Crane.—In rigging, a crane specially adapted for use on wharves. It is a fixed well crane of the triangular form, consisting of pillar or post, jib and ties, and usually worked by hand.

Wharfinger.—A man who owns, or has care of a wharf.

Wheal.—A more or less elongated mark raised by a stroke; also, a similar mark made by any cause; a *wale*.

Wheel.—A circular form, either a solid disc, or a structure in which a *rim* and *hub* are united by rays or *spokes*, capable of revolution on its own axis; and used to support a vehicle; as, a cart wheel; to transmit motion; as, a pulley, or, as a mechanical power.

Wheel and Axle.—One of the elementary mechanical powers, consisting of a wheel fixed to an axle used for raising great weights by applying the power to the circumference of the *wheel*, and attaching the *weight* by a rope or chain to that of the *axle*.

Wheelbarrow.—A light frame with a box for conveying articles, having two handles and one wheel, and rolled by a single person.

Wheel Cant.—In mechanics, a segment of the rim of a wooden gear wheel.

Wheel Case.—In hydraulics, the casing around the revolving part of a water turbine. It may or may not contain the guide blades, according to the type of machine.

Wheel Center.—In a locomotive, the wheel proper, which is keyed to the axle, and on which the tires are shrunk. Formerly forged out of wrought iron, with many welds, but now generally of cast steel. Truck and tender wheels are frequently cast iron, sometimes with a tire, and sometimes with a chilled rim.

Wheel Colter.—A sharp edged wheel running in advance of the breast of a plow, to cut the sod or weeds in the line of the furrow.

Wheel Draft.—In steam boilers, when the current of smoke and hot air is continued round and round in the same direction. In contradistinction to a *direct* or a *split draft*.

Wheeler.—A maker of wheels; a *wheelwright*.

Wheel Flange.—In railway vehicles, a flange formed on the inner edge of a wheel tire, to keep the railway car or locomotive on the track.

Wheel Guard.—A casing or protection over a revolving wheel.

Wheel Harrow.—A farm implement intended to be dragged over the ground for leveling or pulverizing the soil or covering seed, and running on wheels, as distinguished from the plain harrow which slides on the ground.

Wheelhouse.—In navigation, a small house on or above a vessel's deck, containing the steering wheel.

Wheel Hub.—In mechanics, the boss or nave of a wheel whence the spokes radiate to the rim, and which is bored out for the reception of the axle.

Wheel Hub Liner.—A disc of brass or gun metal fitted on to the inside of a hub to form a wearing surface where it works against the journal box: generally fitted to all the wheels of a locomotive.

Wheeling Plank.—In excavating, a plank to wheel on, or run wheelbarrows over; also called a *run*.

Wheel Jack.—A lifting jack with a low toe, to catch beneath the tire of a wheel; as, used by a wheelwright.

Wheel Key.—In a locomotive, the tapering key fitted half into the wheel seat of an axle and half into the hub of its wheel, to secure the latter in place.

Wheel Marker.—In this device the characters are not impressed by a single contact, but the die is made to revolve at a high rate of speed and the blank is gradually fed to it by means of a weighted lever; the ultimate depth of impression being governed by suitable stops.

Wheel Pit.—In hydraulics, the excavation formed for the reception of a turbine, or other water wheel.

Wheel Pumps.—Fly wheel pumps worked by hand, fitted for use in emergencies.

Wheel Steering.—In navigation, the act of steering a vessel by turning a wheel, which controls the levers operating the steering apparatus.

Wheel Tread.—In a locomotive, that part of the tire which bears on the rails. It is coned to permit a larger diameter to revolve on the outer rail than on the inner when going round curves, thus allowing for the greater distance traveled by the *outer wheel*, and preventing strains on the axle.

Wheel Valve.—A stop or gate valve opened by means of a hand wheel and screw, as distinguished from those patterns of gate valves in which the valves are opened or closed quickly by means of levers, or the many types of butterfly and other throttle valves.

Wheelwright.—One who makes wooden wheels for vehicles; by extension, a maker or repairer of commercial road vehicles, or those not included in the art of the carriage builder.

Whereabouts.—The place where a person or thing is; as, they did not know his whereabouts.

Wherry.—A light, sharp built boat, usually pulling one pair of oars or sculls, used as a racing boat; also, for carrying passengers short distances.

Whetstone.—A stone used for sharpening cutlery or edge tools by friction. It is usually a siliceous slate, and the finer varieties are used with oil or water, in such case being termed *oil stones* or *hones*. The *whetstone*, in its modern acceptance, denotes the spindle shaped stone, used to sharpen scythes, sickles, etc.

Whiff.—A sudden expulsion of air from the mouth; a quick puff or slight gust; as, of air or smoke.

Whiffle.—1. In navigation, to waver or shake, as if moved by gusts of wind; to shift, turn, or veer about.

2. To change from one opinion or course to another; to use evasions; to prevaricate; to be fickle.

Whiffletree.—A bar to which the traces of an animal's harness are connected, and whereby the vehicle is drawn.

While.—1. Space of time, or continued duration, especially when short; a time.

2. Under which circumstances; in which case; through; whereas.

Whim.—In mining, a gin; a simple hoisting apparatus, whereby a horse traveling in a circular path, rotates a drum to which it is harnessed through a cross bar, and coils or uncoils a rope on the drum, thus raising or lowering the *kibble* or tub.

Whip.—1. To overlay regularly; as, a rope, so as to form a continuous spiral wrapping; enwrap; also to bind the end; as, of a rope, with yarn to prevent its fraying.

2. A simple form of hoisting apparatus consisting of a rope passing over an elevated single pulley (a single whip) or over two single pulleys, a double whip. It is worked by horses, which, by working away from it, hoist the load attached to the other end of the rope.

3. In millwrighting, one of the arms or frames of a windmill, on which the sails are spread; the length of the arm reckoned from the shaft.

Whip Crane.—A crane of simple construction, for *whipping* or quickly hoisting goods in unloading vessels.

Whip Hand.—The hand that wields the whip in driving or riding.

Whip Saw.—A saw for dividing timber lengthwise, usually set in a frame, and worked by two persons; also a *fret saw*.

Whirl.—A revolving hook used in twisting; as, the hooked spindle of a rope machine, to which the threads to be twisted are attached. *Whirls* are *eddies* in air currents.

Whirlpool.—In hydraulics, an eddy or vortex of water; a place in a body of water where the water moves round in a circle, so, as to produce a depression or cavity in the center, into which floating objects may be drawn.

Whirlpool Chamber.—In hydraulics, a chamber on the discharge side of a centrifugal pump, designed to reduce the whirling motion of the water and thus lessen friction.

Whisk.—1. A plane used by coopers for evening chimes.

2. A little broom or brush; as, of broom corn, bristles, feathers, etc.

Whisket.—1. A small lathe, used for turning wooden pins. It has a hollow chuck, which holds the pin while turning.
2. A basket.

Whistle.—A signaling apparatus, emitting a loud sound, occasioned by steam passing through an annular opening, in the lower of two superimposed bells, and impinging upon the thin vibrating edge of the upper. The size and shape of the bell determine the quality of the note.

Whistle Pipe.—The steam pipe leading to the whistle or syren.

White.—1. Reflecting to the eye all the rays of the spectrum combined; not tinted with any of the proper colors or their mixtures; the opposite of *black*.
2. The white paints of commerce are principally obtained from lead, but preparations of baryta and zinc are also used; the former as an adulteration, the latter as a substitute.

White Brass.—An alloy of copper and zinc, with sufficient of the latter, or of nickel, lead, etc., to give it a white color.

White Core.—In ice making, a milky opaque center to the blocks caused by carbonic acid in the water forming carbonate of calcium in combination with the bone charcoal of the filters.

White Hemp Rope.—Twisted fibers of white hemp, so intertwined as to form a cord capable of sustaining considerable strain.

White Iron.—Pig iron containing but little uncombined or graphitic carbon; also called *forge pig*, because it is especially suitable for conversion into wrought iron by puddling. White pig is usually graded as No. 5.

White Lead.—A mixture of lead carbonate and hydrated oxide; used as paint and in cements. Lead buckles, discs about 7 inches diameter and $\frac{1}{4}$ inch thick are placed in earthenware pots, fourteen or fifteen inches high, with acetic acid. The pots are stacked up into bins, some 40 feet square, and covered with spent tan bark, the whole being left for three months. Steam is given off and a complex chemical action takes place, some 60 to 65 per cent. of the lead being turned into white lead, which is separated by a centrifugal machine, the unchanched lead being remelted, and worked over again. The white lead is ground to powder, and reground to a paste with ten per cent. of linseed oil.

White Liquor.—In sugar making, a bright white syrup used for liquoring loaf or cube sugar.

White Metal.—A name given to an alloy of varying composition, into which tin enters largely, used for the bearing surface of journal brasses. Its elastic nature easily accommodates minute inequalities in the journal, and, therefore, insures more even distribution of the frictional load.

Whitening Stone.—A fine grained stone used by cutters.

White Pine.—The wood of a tree which is one of the most valuable of the twenty-eight species of pines growing in the United States. It is used for pattern work, building construction, furniture, and fancy work.

White Rubber.—Caoutchouc mixed with such quantity of any white pigment as to give a dead white color to it. The ingredients are added in combination with sulphur, so as to make a white vulcanite when heat is applied.

Whitesmith.—A tin plate worker, or one who makes articles out of sheet tin and zinc.

White Tombac.—A white alloy, imitating silver.

Whitewash.—A wash made with slaked lime and water for covering walls, etc. The addition of one pound of tallow (free from salt) or one pound size to each bushel of lime, will make the whitewash adhere better and not flake off. For outside work, one-half bushel slaked lime, one pound common salt, one-half pound sulphate of copper (blue-stone), one gallon sweet milk, is an approved recipe.

White Wood.—The soft and easily worked wood of the tulip tree; much used in cabinet, trim, pattern, and carriage work.

White Zinc.—A beautiful snow white pigment; also known as *Chinese white*. It is the oxide of zinc, and is obtained by strongly heating the metal in an air blast, which oxidizes the metallic vapor as it is liberated. The oxide forms white particles, which are separated from impurities, in a tower or in a series of cooling chambers into which the blast drives them, the purest being carried the furthest.

Whiting.—Pure white chalk which has been washed, worked into large rolls and dried. *Prepared chalk* is the same, only worked into small conical lumps before drying.

Whitney, Eli.—Born 1765, died 1825. An American inventor, famous for his invention of the cotton gin (1792), which revolutionized the picking of cotton, and gave a marvelous incentive to the cotton industry; later (1798), he engaged in the manufacture of firearms of his own design, with considerable success.

Whittemore, Amos.—Born 1759, died 1828. An American inventor. First employed as a gunsmith, he later formed a partnership with his brother for the manufacture of cotton and wool cards. The slow process of punching the leather and setting the wires by hand, led him to devise a machine to do the work rapidly. After considerable discouragement, he perfected and patented his invention in 1797, which established his reputation as an inventor and brought him a considerable fortune.

Whitworth, Sir Joseph.—Born 1792, died 1871. An English mechanical engineer. He began work as a mechanic, making many valuable inventions in metal working machinery: he discovered a method of producing true plane surfaces of metal (1830), designing the well known planer (1833); he perfected and standardized the pitch of screws; he made a standard yard and constructed a measuring machine for exact measurement; later he devoted himself to the manufacture of rifles, and, in 1860, to making high grade cannon, inventing compressed cast steel for that purpose. He received the Albert Medal, and the Cross of the Legion of Honor from France.

Whitworth Thread.—The standard thread for screws, employed in England and her colonies, and on the European Continent. The angle of the thread is 55°, one sixth being rounded off at top and bottom.

Wholesale.—Merchandise in bulk; dealing in large quantities which are purchased directly from the manufacturers or producers, and sold in turn to retailers.

Wholesale Trade.—Dealing in merchandise, in bulk, or large quantities.

Whorler.—A potter's whirling table, on which he shapes circular articles.

Whur.—A humming or whirring sound, like that of a body moving rapidly through the air; a *whir*.

Wick.—1. Fibrous material, either loosely woven or else spun into a bundle, which is used to conduct oil, by capillary attraction, from a reservoir to the flame of a lamp, where the oil is gasified by the heat so as to support combustion. In a candle, the heat of the flame melts some of the fat into oil which is drawn up by the wick.

2. Any collection of soft fibrous material acting like the wick of a lamp or candle; as, used for lubricators, carburetors, etc.

Wick Carburetor.—A variety of surface carburetor, for gasoline motors, in which the volatile fuel is drawn up through a system of wicks, thus exposing a large surface to the air supply and facilitating the absorption of the gasoline.

Wickerwork.—Basket work as made by the interlacing of wickers, otherwise osiers or withes, the twigs of certain willows.

Wicket.—1. A small gate within a larger one; a half door to an opening.

2. A small sluice or opening for letting the water out of a canal lock.

3. A valve or throttle in the chute of a water wheel for regulating the flow of water.

Wide.—Having considerable distance or extent between the sides; spacious across; much extended in a direction at right angles to that of length; not narrow; broad.

Widemouth Socket.—A well borer's fishing tool, in which the socket is fitted with a bellmouth, nearly the full bore of the casing, thus making it easy to grip the ends of broken poles or the like, when lost at the bottom of a well.

Width.—1. Space between sides or extent from side to side; as, the width of the river is half a mile.

2. The state or quality of being *wide*; opposed to narrowness.

Willow.—1. A tree or shrub, well known, and usually growing by or near water-courses. The slender and pliant branchlets or osiers are used for basket work, etc. Some species furnish excellent timber and valuable wood for gunpowder charcoal.

2. A machine in which cotton is opened and cleansed by the action of long spikes projecting from a conical wheel which revolves within a box studded with similar spikes; probably so called from having been originally a cylindrical cage made of willow rods, though some derive the term from winnow, as denoting the winnowing or cleansing action of the machine.

3. In paper making, a machine in which rags are torn to pieces by means of spiked drums rotating within cylinders also furnished with spikes.

Willowing.—The process of cleaning textile materials, wool, cotton, etc., by the use of a willow.

Willow Oak.—An oak tree found on borders of swamps, on rich sandy uplands, and in sandy or pine barrens.

Willy.—A machine for opening and cleansing wool, similar to the willow used in cotton manufactures; called also *twilly*, *twilly devil*, and *devil*.

Wimble.—An instrument for boring holes, turned by a handle; a *gimlet*.

Win.—In coal mining, to perform the preliminary operations of sinking a shaft, etc., to reach the coal; to erect a plant, and develop all preparations for mining, as apart from the actual operations of recovering the coal which are termed *getting*.

Winch.—A steam engine on a ship's deck used for hoisting cargo, etc. It consists essentially of various drums and barrels driven by gearing at different speeds.

Winch Handle.—In machinery, the handle of a crane, crab, or other hoisting machine turned by hand power. It is a lever whose length is the measurement taken from the center of the handle to the center of the spindle. This length is usually one foot, four inches.

Winch Heads.—On a hoisting engine, spools or thimbles attached to the end of the drum shaft.

Wincing.—The act of washing cloth; dipping it in dye, etc., with a wince.

Wincing Machine.—In dyeing, an arrangement of vats in series, for washing, scouring or dyeing fabrics, in which a *wince* or reel is placed between each two.

Wind.—The current of air passing from a part of the atmosphere which is dense to another part which is relatively less dense, the velocity of its passage being measured by the difference in the two densities. The best velocity for driving windmills is from 15 to 20 miles per hour.

Wind.—1. To turn and twist or operate by twisting; as, to *wind* a clock.

2. In architecture, turning and twisting, so that its parts do not lie in one plane; as, with a piece of timber *out of wind*.

3. Moving in and out or across its general course, so as not to go straight but in a sinuous direction.

Windage—1. The rush of air that attends the rapid passage of an object; as, a projectile or a railway train.

2. The free space, or its amount, between some piece and the socket in which it plays or fits; the play between a spindle and its cavity.

Wind Bore.—In mining, the suction part of a pump standing in a cistern or sump, consisting of a cast iron pipe with a belled lower end, perforated to form a *suction rose*.

Windbound.—In navigation, prevented from sailing by a contrary wind.

Wind Bracing.—Diagonal braces in the roof of a building, which stay the rafters from each other, preventing racking.

Windbreak.—1. Anything; as, a hedge, trees, or a high fence, to break the force of wind.

2. A small wooden building, like a sentry box.

Winder.—1. One who, or that which winds; as, a *silk winder*.

2. A reel or swift for winding silk, cotton, or the like.

3. In architecture, one in a flight of steps which are curved in plan, so that each tread is broader at one end than at the other; distinguished from *flyer*.

Wind Furnace.—A furnace in which a strong heat is obtained without the use of bellows, by means of a powerful draft, depending on a narrow flue or a chimney of considerable elevation. Such furnaces are employed in chemical laboratories and in smelting the more refractory metals.

Windgall.—In timber, a defect in timber caused by an old wound, subsequently covered over by a growth of wood. It becomes a center of decay.

Wind Hatch.—In navigation, an opening in the deck of a ship affording passage to the hold, and so arranged that the hood or covering can be turned with its entrance from the wind.

Winding.—1. Twisting from a direct line or an even surface; as, a *winding surface*.

2. That which winds; a spiral turning or coiling; in mining, the act or process of hoisting ore to the surface.

Winding Drum.—In mining, a large cylinder around which the rope is coiled in hoisting coal or ore to the surface.

Winding Engine.—In mining, the steam engine that hoists cages containing tubs or men from the mine to the surface through the shaft. The engine actuating the motion of coal along the passages of the mine, whether it be situated on the surface or underground, is known as the *hauling engine*.

Winding Rope.—In mining, a rope, usually a wire cable, wrapped around the drum of a hoisting engine, used for raising and lowering the cage in a mine shaft.

Winding Stairs.—In carpentry, stairs ascending in a spiral line around a solid or open *newel*.

Winding Tackle.—A purchase of one fixed three sheave block, and a movable double or treble block, suspended from a lower masthead, and used in getting in or off heavy freight or stores.

Wind Instrument.—A musical instrument whose sounds are produced by the vibration of an air column excited either by the breath or by bellows.

Windjammer.—A large schooner rigged seagoing vessel, having sometimes as many as six masts; so called on account of its ability to sail closer to the wind than a square rigged ship.

Windlass.—1. A horizontal drum for winding, or for hoisting by winding.

2. An apparatus for lifting the anchor by means of its cable, sometimes driven by a messenger from a winch, but generally having its own steam cylinders. It is provided with a compressor for holding the gipsy wheels fast and consequently stopping the chain, and a brake to regulate the paying out of cable.

Windlass Jack.—A form of lifting jack having a winch handle for turning the pinion which gears into the crown wheel.

Windmill.—A mill turned by the wind, usually by the action of the wind upon oblique vanes or sails which radiate from a horizontal shaft.

Windmill Governor.—A coiled steel spring located in the base of the vane frame of a modern windmill. It is so adjusted that it holds the disc or fan wheel in the teeth of the wind under ordinary pressures, but yields when the pressure becomes that of a storm, liable to damage the machinery.

Windmill Pump.—A well pump of reciprocating type, actuated through a crank driven by a windmill. A reservoir or supply tank is generally erected in the windmill derrick, a float in this tank throwing the pump out of gear when full, and engaging it once more as the water level falls. This prevents overflow and saves the tank from getting dry.

Windmill Sails.—These are usually made rectangular, with a length of five times their breadth, the total amount of surface being about one-fourth the area of the circle described by their motion.

Window.—An opening in the wall of a building for the admission of light and air, usually closed by doors or sashes containing some transparent material, as glass, and capable of being opened and shut at pleasure.

Window Blind.—In carpentry, a blind to intercept the light passing through a window.

Window Bole.—In carpentry, the part of a window closed by a shutter which can be opened at will.

Window Catch.—A device usually of brass or cast iron, fastened on the sashes of a window to secure a proper locking. Also called *sash lock*.

Window Frame.—In carpentry, the frame of a window which receives and holds the sashes.

Window Glass.—In glass making, common glass made by the familiar blowing and whirling processes.

Window Jack.—A scaffold for carpenters, painters, or cleaners, enabling them to reach the outside of a window. The frame has pivoted brace bars to rest against the outside of the house, and holdfasts hinged to an adjustable block which rest against the inside of the window frame.

Window Lift.—A finger hold, usually of metal, attached to the sash of a window, to raise or lower it.

Window Sash.—A light frame in which panes of glass are set for windows.

Window Screen.—In carpentry, a frame work covered with cloth or gauze to provide a room with a shelter or means of concealment.

Window Seat.—In architecture, a seat arranged in the recess of a window.

Window Shutter.—In architecture, a shutter or blind used to close or darken windows.

Window Sill.—The flat piece of wood at the bottom of a window frame, so constructed that the water falls away from the window in case of rain.

Wind Power.—The force of the atmosphere in motion exerted upon the vanes or sails of windmills and various other motors.

Wind Pressure.—In physics, the crushing power or force of the wind against some obstacles or opposing force.

Wind Sail.—In navigation, a canvas tube distended by hoops, and provided with a large winged head spread by guys or a spar, used to ventilate the interior of a ship.

Wind Tight.—So tight as to prevent the passing through of wind.

Wind-up.—1. To coil round and round; to bring into a smaller compass; as, a ball of twine.

2. To hoist; as, with a winch and rope.

Windward.—The point from which the wind blows; situated toward the point from which the wind blows; as, the windward shrouds. The opposite of *leeward*.

Wineglassful.—As much as a wineglass will hold, usually reckoned at two fluid ounces, or four tablespoonfuls.

Wing.—1. In carpentry, a projection or extension of a building on the side of the main portion.

2. In hydraulics, a shore dam or jetty for narrowing a channel; also, an extension of a dam at either end, usually built at an angle.

Winged Dividers.—Compasses or dividers, such as are used by carpenters, pattern makers, etc., having a *quadrantal wing* projecting from one leg through a slot in the other. The set screw on the slotted leg enables the instrument to be securely locked when the dimension has been taken.

Wing Gudgeon.—A metallic shaft forming a journal for water or other wheels, having wooden axles. The wings are let into the ends of the wood and confined by wrought iron bands put on hot, which become tight by shrinking.

Wing Nut.—A nut fitted with long projections or wings so that it may be operated without need of a spanner. The nuts used to fasten a mud box or valve box cover are usually *wing nuts*; a *thumb nut* is much the same thing, only smaller.

Wing Rail.—In railway engineering, a *guard rail* at a switch.

Wing Tank.—In a locomotive, a water tank carried at the side over the wheel casing. It is considered safer than a *saddle tank*, as the center of gravity is not so high.

Wing Valve.—A valve fitted with three or four wings which guide it in its seat, as distinguished from a *spigot valve* which is guided by a central spigot.

Winnowing.—The process of separating threshed grain from dust, chaff, etc., by a combination of sifting and blowing machines.

Winze.—In mining, a subsidiary vertical shaft sunk from one level to another, for exploration, ventilation, or preparatory to *stopping*.

Wipe.—1. Act of rubbing; especially in order to clean.

2. A blow; a stroke; a hit; a *swipe*.

Wiped Joint.—A lead joint in which the molten solder is poured upon the desired place, after scraping and fitting the parts together, and the joint is *wiped up* by hand with a moleskin or cloth pad while the metal is in a plastic condition; it makes a neat and reliable connection in the pipe.

Wiper.—1. In valve motion, a cam which projects from a horizontal shaft and acts periodically upon a toe whose elevation lifts the valve rod and puppet valve.

2. A person who cleans machinery, especially in locomotive roundhouses and on large steamers.

Wiper Wheel.—The wheel or disc to which the cams of helve hammers and stamping machines are attached.

Wire.—1. A slender rod, strand, or thread of ductile metal, usually formed by drawing through dies or holes; as, nail wire.

2. In paper making, the endless wire cloth upon which the pulp travels through the Fourdrinier or continuous paper making machine.

Wire Annealing.—Softening a wire by heat after it has been hardened by drawing or by exposure to cold after heating.

Wire Binder.—A soft annealed wire which is easily twisted into a loop and used to bind together bundles and bales.

Wire Brush.—In a foundry, a brush used for the *fettling off* of castings. It is like an ordinary hand brush in shape, but the place of bristles is occupied by thin elastic fibers of steel, by which the sand and dirt are scraped off the surfaces of iron castings.

Wire Cloth.—A fabric whose woof and weft are of wire; the size of the wire, the shape and sizes of the meshes, being adapted to the uses of the completed screen, sifter, or sieve, or the character of the machine in which it is to be used. Besides the purpose of separating materials of different finenesses, screens are used in hat forming machines and bran dusters; also fire and window screens and guards, kiln floors, etc. One of the most important uses of wire cloth is in paper making machines.

Wire Cut Bricks.—Machine made bricks manufactured from plastic clay. The clay, after proper tempering and *pugging*, is forced by the machine through an orifice which makes it into a long rectangular bar. As this bar is fed along, a *wire* cuts it up into lengths exactly suitable to make a brick. Such bricks are distinguished by having no *frog*.

Wire Drawing.—1. To form; as, a piece of metal, into wire, by drawing it through a hole in a plate of steel.

2. Wire drawing of steam occurs when in its passage through piping, etc., it becomes extremely attenuated or thin; the effect on steam passing through a constricted valve or other openings and passages.

Wire Drill.—A fine twist drill made to the sizes of the wire gauge, so that holes can be made accurately to size for the reception of wire rivets, etc.

Wire Feed.—A device applied to the hollow mandrels of screw machines, etc., whereby the rod or wire may be pushed forward through the spindle as each piece is completed, and placed in position for the tools

to operate on the new piece. It consists essentially of split bushings and a system of toggle joints, whereby the wire is gripped and slid along.

Wire Gauge.—1. A gauge for measuring the diameter of round wire, according to an arbitrary standard, generally a long graduated plate with a series of slots of diminishing width.

2. A standard system of sizes for wire.

Wire Gauze.—Wire woven into gauze, having a fine mesh. It is sometimes employed in making steam joints, the gauze being cut to the size and shape of the flanges, and smeared with red or white lead previous to the bolting together of the flanges.

Wire Glass.—Wire netting embedded in sheet glass, used in roof coverings for factories, etc., so that if the glass be broken few fragments will fall.

Wire Machine.—A machine or device used by tinnerns for bending the edges of tin pans over a wire so as to form a brim.

Wire Nail.—A nail made from wire with a swaged head and point, or one forged in imitation thereof; chests and boxes from the Continent of Europe and from Asia have long been fastened with nails of this character.

Wire Netting.—A coarse, wire fabric, used for making screens, etc.

Wire Pliers.—Pliers in which a pair of smooth jaws, circular in section and tapered lengthways, are substituted for the ordinary flat and roughened jaws, their purpose being the bending of wire into small curves and loops.

Wire Rope.—A rope made by twisting together small wires.

Wire Rope Socket.—A socket by means of which a wire rope is attached to another part. One plan consists in stranding or opening out the rope within the coned socket and driving in a conical wedge from the opposite end, by this means the strain on the rope tends to tighten the wedge. A better plan is to curve back the various strands within the socket, so as to resemble a mushroom or umbrella. The space is then filled with melted lead or babbitt metal, which secures all. The socket is provided with eyes, male or female threads according to the proposed connection.

Wire Stitching Machine.—A machine used by bookbinders for stitching, binding and stapling books, leaflets, etc.

Wire Work.—A general term for all articles made from wire, woven, twisted or bent; such as screens, baskets, flower-stands, and many other purposes.

Wire Wrench.—A spanner or key whose shank is made of *twisted wire*, for the sake of lightness, as in a bicyclist's equipment.

Wiring.—1. The fitting or application of wire to any purpose.

2. In electrical work, the putting in place of the various conductors within a building.

3. In electroplating, the suspension of articles in the plating baths, by means of hooks, slings, or baskets of wire.

4. In tinsmithing, reinforcing the edges and seams of hollow ware with wire, over which the tinplate is lapped or crimped.

Wisdom.—The quality of being wise; knowledge, and the capacity of making due use of it; knowledge of the best ends and the best means; discernment and judgment; discretion; sagacity; skill.

Witchet.—A rounding plane; a kind of plane with a conical aperture and inclined knife, which reduces to roundness a bar which is rotated as it is passed through.

With.—This word as used, commonly denotes some situation or relation of *nearness*; proximity; association; connection, or the like.

Withdraw.—To take back or away; as, what has been bestowed or enjoyed; to draw back; to cause to move away or retire; as, to withdraw capital or the like from a business.

Withes.—In building, the partitions separating the various flues within a chimney stack from one another.

Without.—Not with; otherwise than with; in absence of, separation from, or destitution of.

Withy.—The willow or osier used in basket making, wickerwork, etc. Also termed *with* or *withes*.

Witness.—1. To see or know by personal presence; to have direct cognizance of.

2. To give testimony to; to testify to; to attest.

Wits.—In mining, tin ore freed from earthy matter by stamping.

Wolf.—In manufacturing, a beating or opening machine for tearing apart the tussocks of cotton as delivered in the bale. It is a preliminary operation, by which dust and trash are rendered separable, and the fiber delivered in a more downy condition, so as to subsequently form a *lap*.

Wolf's Bottles.—In ammonia dehydrating apparatus, separators in which the ammonia vapor, after being liquefied for the first time, escapes into gas and deposits most of the aqueous vapor it has brought over with it from the still.

Wood.—The substance of trees; the hard substance which composes the body of a tree and its branches, and which is covered by the bark; timber. Wood as a combustible, is divisible into two classes: (1) The hard, compact and comparatively heavy wood, such as *oak*, *ash*, *beech*, *elm*; (2) The light colored, soft, and comparatively light woods, as *pine*, *birch*, *poplar*.

Wood Alcohol.—Impure *methyl alcohol* obtained from the destructive distillation of wood in closed vessels or retorts. The watery distillate which first comes over is termed *pyroligneous acid*, making about 10 per cent. of the whole derived from the wood. This is mixed with slaked lime and redistilled to eliminate acetic and other acids; it is redistilled a second time with sulphuric acid to remove bases; a third time over quicklime to remove water, this giving the crude *wood spirit* or *wood naphtha*. This is used as a denaturant for alcohol, 10 per cent. of it being added to *ethyl alcohol* for making *methylated spirit* or *denatured alcohol*. For further refining, calcium chloride is added to the crude alcohol, forming a crystalline solid, which is filtered and pressed, treated with water and redistilled, giving methyl alcohol and water, which is dehydrated over quicklime as before.

Wood Carpet.—A floor covering made of slats or more ornamental shapes, glued or cemented upon a cloth backing. The slats or strips of wood are of different colors, and are arranged to produce all the effects of tessellated floors, mosaic work, etc.

Wood Charcoal.—A variety of fuel or carbon, prepared by heating or charring wood *out of contact with air*; either in retorts or else in stacks in which a retarded combustion is effected. The carbon thus obtained is nearly pure; it is light and extremely porous, possessing the power of absorbing gases, and hence, sometimes used as a deodorizer. The charcoal obtained from *willow* is used in the manufacture of gunpowder, and also in the form of crayons for drawing.

Woodcut.—In book making, an engraving on wood; also a print of it.

Wooden Brick.—A brick shaped block built into a wall, to afford nail hold in securing the inside woodwork.

Wooden Pipe.—These were common in ancient Rome in ordinary structures. Lead was used for the superior class of work in conducting the water of the aqueducts to the fountains and baths. For centuries they have been out of use, but recently they have come in use again for sewerage, or where large pipe lines are required. The difference between the wooden pipe of this period with that of years ago is that the present pipe is made of wooden staves, secured by *iron hoops*, while the ancient pipe was bored out of *solid blocks*.

Wood Grinder.—A machine for rasping wooden blocks, to make paper pulp; also called *block grinder*, *pulp grinder*.

Wood Pavement.—The paving of city streets with blocks of wood; the blocks being usually 9 inches long, 6 inches deep and 3 inches wide. One of several systems for *laying* is as follows: The street is excavated and a *foundation* of concrete put in, this being carefully leveled and struck to the proper radius. On this the blocks are laid, the fibers being vertical and the rows across the traffic. The joints between the blocks are filled with cement grout or melted pitch, sometimes both being used, one after the other.

Wood Propeller Pump.—In hydraulics, a pump which lifts the water by propeller screws or runners made of wood. The runners consist of two half circular inclined blades fastened to a shaft at intervals of three to five feet, and of slightly less diameter than the casing, so as to revolve freely within it.

Wood Pulley.—A pulley wheel formed from wood; when new the wooden surface gives better adhesion for the belt, although this advantage disappears as the pulley gets polished.

Wood Pulp.—A material for paper making, obtained from the wood of the white pine or poplar. The wood is disintegrated by attrition against millstones, or is ground into fibers by discs, armed with knives. The shreds are digested with various chemicals to form *cellulose*, and the pulp is subsequently treated in the same manner as that obtained from rags.

Wood Screw.—A screw nail, having a flattened right handed thread to give good grip, a gimlet point to enter the wood and a nicked head for the reception of the screw driver.

Wood Steamer.—In wood working, a chamber or vessel in which timber or wooden scantlings are exposed to steam,

rendering the pieces flexible and plastic, so that, when drawn out, they may be bent to any desired curvature. The shape is retained if the wood is locked in place and allowed to dry out to the desired curve; also called *steam box*.

Wood Turning.—In pattern making wood turning is an essential section of pattern work, and is not performed by professional turners but by the pattern maker himself, who alone can know the conditions necessary to be observed. The work is seldom ornamental and much of it is done by scraping tools.

Wood Working.—The various arts and businesses connected with the manufacture of building materials, furniture, etc., from wood. It includes the work of the saw mill, carpentry, joinery, wood turning, wood carving, etc.

Woof.—The threads that cross the *warp* in weaving; also called the *weft*.

Wool.—That soft, curled, or crisped species of hair which grows on sheep and some other animals, and which in fineness sometimes approaches to fur; chiefly applied to the fleecy coat of the sheep, which constitutes a most essential material of clothing in all cold and temperate climates.

Wool Carding.—The process of disentangling and separating the fibers of wool, and delivering them in a parallel condition suitable for spinning. This was formerly done by means of two hand combs, one of which was fixed in a stationary frame; to facilitate the work, the combs were warmed in a charcoal pot. At the present time the operation of carding is confined to the ordinary stapled or merino wools, which possess the property of *felting*, and is effected by cylinders warmed with steam, and covered with card clothing.

Wool Cleaner.—A machine for beating, shaking and cleaning wool, previous to scouring and dyeing.

Wool Combing.—The process of dealing with long-stapled wools, which are to be used in worsted manufacture. The operations are akin to those of carding, and are effected with what is termed a *gilling* machine.

Wool Oiler.—In woolen manufactures, an attachment whereby a reservoir laterally traverses the wool as it is fed into the carding engine, to oil the fibers for the purpose of preventing felting in the subsequent processes.

Wool Sorting.—The act or process of sorting wool into lots according to length of staple, fineness, softness, color, strength, cleanness and weight.

Wool Stapler.—One who deals in wool; one who sorts wool according to its adaptation to different manufacturing purposes.

Wool Washing.—The process necessary to remove the *suint*, or natural grease, and dirt from the fleece; it is effected first in alkaline liquor which *saponifies* the grease, and then in fresh water.

Wool Washing Machine.—A machine in which wool is scoured or washed, first with alkaline liquor and then with fresh water to extract the *suint* and clean the material.

Wooze.—In leather manufacture, a *tan liquor*, or solution of some tannin bearing material, in which the hides or skins are steeped.

Worcester, Edw. S. (Second Marquis of).—Born 1601, died 1667. English inventor of the steam engine. He passed much of his time in experimental work at Raglan Castle, his father's seat. Being sent by the King, in 1645, to Ireland, to treat secretly with the Roman Catholics, his mission was betrayed and he was imprisoned for treason. Escaping, he remained in exile till 1652, when he returned, and was incarcerated in the Tower till 1654. His "Century of Inventions" was published in 1668. Among these is an admirable and most forcible way to drive up water by fire. In fact, he anticipated the steam engine. He erected waterworks at Vauxhall.

Word.—The spoken sign of an idea; a vocal sound, or a combination of vocal sounds, uttered by the human voice, and by custom expressing an idea or ideas; a single component part of human speech or language; a constituent part of a sentence; a *term*.

Wordle.—One of several pivoted pieces forming the throat of an adjustable die, used in drawing wire, lead pipe, etc.

Work.—1. Effort directed to an end; toil; labor; employment; particularly in man, manual labor.

2. In mining, ores before they are prepared or dressed.

Workable.—Capable of being worked or worth working; as, a *workable* mine.

Worker.—In manufacturing, one of a pair of small cane cylinders, called *urchins*, which are arranged around the

large card drum of the carding machine. The *worker* is larger than its fellow *urchin*, the *cleaner*. The former takes the fiber from the large card cylinder, parts with it at the cleaner, and the latter returns it to the card cylinder.

Working Barrel.—In hydraulics, the pump barrel in which the piston works.

Working Beam.—In steam engineering, the beam of a Cornish or beam engine, having the piston rod at one end and the pump rod at the other.

Working Day.—1. A day not a legal holiday; a work-day.

2. The number of hours constituting a day's work; as, a *working day* of eight hours.

Working Drawing.—In mechanics, a drawing; as, of the whole or part of a structure, machine, etc., made to a scale and fully dimensioned so as to be the guide in its construction.

Working Home.—A term used in coal mining, when roads are first driven to the boundary line, and the coal worked out *afterwards*, while proceeding towards the shaft, and the roof falling into the *goaf* behind the working face.

Working Out.—In coal mining, the reverse of *working home*; the method of excavation whereby the workings recede from the shaft as the coal is got, the roadways being maintained through the *goaf*, or through pillars purposely left to support them.

Working Point.—That part of a machine at which the effect required is produced.

Working Pressure.—The safe working pressure to which a boiler is subjected; this is usually estimated to be one sixth of the bursting pressure.

Workings.—Those portions of a mine, quarry, or other excavation where recovery of the ore or mineral is being carried on.

Workman.—1. A man employed in manual labor; sometimes a skilled and accomplished mechanic.

2. A man engaged in any labor; as, in literature or art; a worker.

Workmanlike.—Becoming a workman, especially a skilful one; a task well performed.

Works.—A manufacturing or other industrial establishment; as, a bridge works.

Workshop.—A place, apartment, shop or building, within which any workman, mechanic, or artisan, or a number of the same, carry on their work or handicraft.

Works Manager.—The superintendent of a plant, shipyard, or works of any description; the official actually responsible for carrying out the work; as apart from design, accounting, selling or office duties.

Worm.—1. An auger-like tool used in boring rock.

2. A spiral coil; as, of a pipe; a coil used for condensation in connection with a distilling apparatus; a *worm pipe*.

3. Something thought to be like a worm, in appearance or movement; as, a *screw thread*.

Worm Gear.—Spiral gearing in which a worm or screw is used to rotate a wheel with suitably shaped teeth; a worm wheel.

Worm Wheel.—In machinery, a wheel which gears with an endless screw or worm, either receiving or imparting motion.

Wornout.—Consumed or rendered useless, by wearing, use or friction; as, a *worn out* hoisting engine.

Worsted.—Well twisted yarn, spun of long staple wool which has been combed to lay the fibers parallel, used for carpets, hosiery, gloves, and the like.

Worsted.—In mechanics, filaments of worsted or wool conducting oil by capillary attraction, from a reservoir into the lubrication ducts of a bearing; used chiefly on marine engines.

Wounds.—In surgery, a disruption of the soft parts of the body due to external violence. Treatment: First arrest bleeding, cleanse the wound, keep the wounded parts, if possible, at rest by the application of slings or splints. Protect the wound from outside dust and dirt by means of some antiseptic dressing material. Treat constitutional symptoms, if any, such as shock or fainting.

Wove.—Any article that has been produced by weaving.

Wrap.—1. In silk weaving, *to wind*.

2. In cloth industry, to fold together; to arrange to fold.

3. To cover by winding or folding; to envelope completely; to enfold.

Wrapper Plate.—In a locomotive, the plate or plates forming the sides and crown of the external fire box.

Wrecker.—1. Any one whose vocation is pulling down or dismantling things, such as tearing down old buildings and clearing the site. One who clears the ground after a fire or other catastrophe.

2. A salvor; the salvage associations are termed *wrecking* companies.

Wrecking Car.—In railway operating, a car bearing an outfit of tools and a powerful crane, used to clear the tracks, etc., after a railway accident. The larger cars, operated by steam, can lift a locomotive. Also known as *derrick car*, or *tool car*.

Wrecking Crew.—In railway operation, the men working on a car which carries devices for removing obstructions from the track; such as, wrecked cars or locomotives, fallen rocks, or trees.

Wrecking Frog.—A re-railing device, having two inclined planes, up which the wheels of a car are made to travel by pulling it in the direction of its length, until the flanges ride over the rail.

Wrecking Pump.—In navigation, a large centrifugal pump, used for salvage purposes.

Wrench.—1. To twist violently; to turn suddenly by force or with a straining effect.

2. In mechanics, a spanner or key for twisting or turning bolts, nuts, pipe or the like; or *adjustable*, to fit a bolthead, or other object to be turned.

Wrest.—1. A turning instrument, such as a wrench, turning key, spanner, etc.

2. In hydraulics, the partition in a water wheel by which the form of the buckets is determined.

Wring.—To twist and compress; to turn and strain with violence; to squeeze hard; to pinch; as, to wring clothes in washing.

Wrinkle.—To contract into furrows and prominences; to make a wrinkle or wrinkles in; to corrugate; hence, to make rough or uneven in any way; as, a sheet of iron in making *corrugated iron*.

Wrist.—1. In machinery, a stud or pin which forms a journal; also called *wrist pin*.

2. In steam engineering, the *wrist* or *wrist plate*, a swinging plate bearing two or more wrists, for operating the valves; as, in the Corliss engine.

Wrist Pin.—1. On a steam engine, a pin held by the crosshead and by which the movement of the piston rod is imparted to the connecting rod.

2. The crosshead pin within the trunk piston of an *internal combustion engine*, such as a gasoline motor.

Wrist Plate.—One of the characteristic features of the Corliss steam engine. The eccentric drives a wrist plate, or circular disc vibrating upon a stud at the side of the cylinder. The various valves are operated from studs or pins in the face of the wrist plate; the construction is such that the valve receives a rapid motion at cut-off, thus minimizing wire drawing. Double eccentric engines have two wrist plates, one for steam and one for exhaust. They are usually fitted to heavy duty engines which require a long range cut-off.

Wrought.—1. Worked.

2. Any metal is said to be wrought when it has been worked to its shape or state while heated, by forging, hammering, rolling or pressing, as distinguished from *cast*, or having been poured while molten into suitable moulds, or *drawn*, similarly to wire, through dies.

3. A term used by masons and carpenters in contradistinction to *rough*.

Wrought Iron.—The purest form of useful iron, prepared from *forge*, *pig*, or white cast iron by *puddling* and *shingling*. The resultant bar of wrought iron contains about one per cent. of *cinder*, i. e., carbon

and impurities, and, to eliminate these, further processes of *fagoting* and *piling* are resorted to. Judicious crossing of the fibers in these operations gives wrought iron its characteristic silky fiber, while each stage of the reworking results in a superior grade, freer from carbon, etc., there being often less than 0.25% of carbon in a good quality bar. The successive products are known as *merchant iron*, *best*, *best best*, etc., different firms having a special brand for irons above the third working. Specially good irons undergo a preliminary refining process before puddling.

Wrought Iron Pipe.—In steam fitting, a common welded pipe. As listed, the sizes given are nominal inside diameters, the actual diameters being larger; thus, an $\frac{1}{2}$ inch pipe has an inside diameter of $\frac{1}{4}$ inch. Pipes from $\frac{1}{4}$ " to 1", inclusive, are usually butt welded; those of standard thickness are tested to 300 lbs. per sq. in., while the larger sizes are lap welded and tested to 500 lbs. per sq. in. Wrought iron pipes are made in several weights for different pressures. Wrought iron pipe can easily be bent at a red heat, its connections easily made with T's, elbows, crosses, and screwed unions and sockets; faulty tubes seldom are found.

Wrought Iron Pulleys.—In machinery, these have largely superseded cast iron pulleys, from their superior lightness and reliability. The rims are framed of wrought iron or steel and the arms are of the same material, each being made distinct from the other; they are put together in halves and are, therefore, *split pulleys*.

Wry.—Turned to one side; twisted; distorted; hence, deviating from the right direction; misdirected; out of place.

Wych Elm.—A species of elm; also called *Scotch elm*.



X.—1. A letter; the twenty-fourth in the English alphabet.

2. Something in the shape of a letter \times ; as, an \times piece in a framing.

x.—The symbol used in arithmetic, algebra, etc., to express an unknown quantity.

Xebec.—A small, sharp built, three masted vessel, carrying both square and lateen sails, variously arranged; a Mediterranean craft, formerly widely known as a piratical ship.

X Spring.—A carriage spring, composed of two superposed laminated springs, forming a letter **X**.

Xylantrax.—Wood coal, charcoal, or any other coal produced by burning, so called in distinction to *mineral coal*.

Xylene.—In chemistry, any one of a group of three metameric hydrocarbons of the aromatic series, so named because found in crude wood spirit. They are colorless, oily, inflammable liquids.

Xylography.—House decoration by a method of color printing on wood.

Xylonite.—The same as *celluloid*. A mixture of camphor with pyroxylin. The camphor is heated and the pyroxylin added, the whole worked into a mass under rollers, the color being added before working.

After this the mass is warm pressed into the desired forms. It is used for carriage fittings, ornaments, and other substitutes of *ivory* and *bone*. The material is highly inflammable but not explosive.

Xylophone.—1. In mechanics, an instrument to determine the vibrative properties of different kinds of wood; as, relating to strains and stresses of timber, to be used in construction.

2. An instrument consisting of strips of wood or glass graduated in length, and struck with small hammers.

Xylopyrography.—The art or practice of burning pictures on wood, with a hot iron.

Xyst.—In architecture, a long and open portico.

Xyster.—An instrument for scraping bones.



Y.—1. The twenty-fifth letter of the English alphabet.

2. In railway engineering, the triangle formed by two curving spurs from a main track. This is much used, wherever practicable, to turn trains or engines, without uncoupling, or using the turntable.

3. A pipe fitting, where two branches unite together to form one, resembling the letter Y in appearance. The enclosed angle is usually 45° .

Yacht.—A light, trim, swift sailing or steam vessel, usually comparatively small; a pleasure vessel.

Yank.—A shop term, meaning to pull or wrench with undue violence.

Yard.—1. A standard measure of length, subdivided into 3 feet or 36 inches. The lineal yard is much used in textile industries; both the *lineal* and *cubic* yards are employed in civil engineering, etc. The latter is the unit of excavation in construction.

2. In navigation, the horizontal spar on which square sails are set.

Yardage.—A term employed by engineers in estimating the amount of material scooped up by the *dipper* of a steam shovel; as, the *yardage* removed by 74 steam shovels in the excavation of the Panama Canal, in May, 1908, was 2,702,897; *i. e.*, cubic yards.

Yarding Engine.—A locomotive used in a station yard for switching cars, making up trains, etc.

Yard Man.—A workman employed about the yard of a railroad station, to aid in making up trains and the like.

Yard Master.—In railway engineering, one who has charge of all work in the yard of a railway station. He is responsible for switching, placing of trains, etc. He is generally selected out of experienced train conductors.

Yardstick.—A graduated stick three feet in length, used for measuring.

Yard Traveler.—In machine work, an overhead traveler used for lifting heavy work about the yard of a machine shop, both for erecting and loading. They are worked by hand or power with ordinary gear,

or with hemp ropes.

Yarn.—1. Spun wool; woollen thread; also thread of other materials; as, of cotton, flax, hemp, or silk; material spun and prepared for weaving.

2. In rope making, one of the threads of which a rope is composed.

Yarning Tool.—A set or blunt chisel for caulking yarn into the bell of a pipe joint, preparatory to pouring lead; a *yarning* chisel.

Yarrow, Alfred Fernandez.—An English engineer and naval architect. He was first engaged in the design and construction of steam plows and road wagons, but, later, turned to the building of steam vessels. His reputation was made when he successfully developed shallow draft boats for river service.

The firm of Yarrow & Co. is now chiefly distinguished for the construction of shallow draft gunboats and river boats, built often in floatable sections for easy transportation for use on such waterways as abound in South America and Africa, hitherto not possible of navigation by steam craft.

Yaw.—In navigation, a movement of a vessel by which it temporarily alters its course; a deviation from a straight course in steering.

Yawl.—1. A small sailing vessel rigged like a sloop, with the addition of a jigger mast.

2. A ship's small boat; jolly boat.

3. A small fishing boat.

Year.—The time of the apparent revolution of the sun through the ecliptic; the period occupied by the earth in making its revolution around the sun, called the *astronomical year*; also, a period of time more or less nearly agreeing with this, adopted by various nations as a measure of time, and called the *civil year*.

Year Book.—A book published yearly; any annual report or summary of the statistics or facts of a year, designed to be used as a reference book.

Yearly.—1. Happening, occurring, or coming every year; annual; as, a *yearly* income; a *yearly* salary.

2. Lasting a year; as, a *yearly* contract.

3. Accomplished in a year; as, a *yearly* trip.

Yellow.—One of the three primary colors (red, yellow and blue), much used in drawings. It is the color of gold, butter, etc., and is usually represented in engineering drawings by gamboge, for gun-metal, etc.

Yellow Brass.—In metals, an inferior kind of brass formed of an alloy of copper seventy parts, zinc thirty parts, and used for the commoner class of turned and other work, also for name plates and similar castings when durability and strength are not essential.

Yellow Metal.—A sheathing alloy of copper two parts, with zinc one part.

Yellow Ochre.—An impure hydrated form of ferric oxide, found in many parts of the world. The pigment is ground and then levigated. It is dried at low temperature so as not to change the color, and then ground in linseed oil. The colors of ochres range from very light yellow to reddish brown. Golden yellow ochres are frequently admixed with chrome yellow to brighten them.

Yesterday.—The day last past; the day before the present.

Yield.—1. To give in return for labor expended; to produce; as, payment or interest on what is expended or invested; to pay; as, money at interest yields six per cent.

2. To give up, as something that is claimed or demanded; to make over to one who has a claim or right; to resign; to surrender; to relinquish.

Yield Point.—In physics, in testing materials, the point at which the stresses and the strains become equal, so that deformation or *permanent set* occurs. The point at which the stresses equal the elasticity of a test piece.

Y Level.—An instrument for measuring distances and altitudes.

Yoke.—1. A frame or clamp for holding the parts of a machine in place.

2. The frame formed in a slide valve spindle, to embrace the box like portion of the slide valve and thus form the connection.

3. The frame which swings the signal bell in a locomotive.

4. The iron portion connecting the magnetic limbs of an electro-magnet.

5. A pipe with two branches; as, for hot and cold water, uniting them to form one stream.

Yoke Arbor.—A form of double journal box for pulley spindles, in which a curved branch extending from one bearing to the other on each side of the pulley, serves to protect the belt from being chafed or otherwise injured.



Z.—The twenty-sixth and last letter of the English alphabet.

Zante Wood.—A yellow dye wood; also called *zante*.

Zax.—A large knife or chopper used by slaters to dress slates. The blade is about 16 inches long, with a width of 2 inches, and is furnished with a spur on the back for perforating the slate to form the nail holes. This tool is not so much used as formerly, slates being received from the quarries ready sawed to correct sizes, and the holes are now punched or drilled by means of a special press.

Zebra Wood.—A kind of cabinet wood having beautiful black, brown and whitish stripes.

Zenith.—That point in the visible celestial hemisphere which is vertical to the spectator; the point of the heavens directly overhead; opposed to *nadir*.

Zenith Telescope.—A telescope specially designed for determining the latitude by means of any two stars which pass the meridian about the same time, and at nearly equal distances from the zenith, but on opposite sides of it. It turns both on a vertical and a horizontal axis, is provided with a graduated vertical semi-circle, and a level for setting it to a given zenith distance, and with a micrometer for measuring the difference of the zenith distances of the two stars.

Zero.—Cipher; nothing; naught; the point from which the graduation, as of a thermometer, commences.

Zero, in the thermometers of Celsius and Réaumur, is at the point at which water congeals. The zero of Fahrenheit's thermometer is fixed at the point at which the mercury stands when immersed in a mixture of snow and common salt. In Wedgwood's pyrometer, the zero corresponds with 1077° on Fahrenheit's scale.

Zero Point.—The point indicating zero, or the commencement of a scale or reckoning.

Z Frames.—Ribs of a section like the letter Z, composed of two reversed angle bars.

Zigzag.—Having short, sharp turns; running this way and that in an onward course.

Zigzag Riveting.—A shop term, in steam boiler construction, used where the rivets are put in a zigzag manner, thus forming double rows; *chain riveting*; also *triple riveting*.

Zinc.—A metal of brilliant white color, with a shade of blue, and appearing as if composed of plates adhering together. It is not brittle, but less malleable than copper, lead, or tin; when heated, however, it is malleable and may be rolled into plates. It is used to give a protective coating to iron articles dipped in a bath of the molten metal; in the form of ground oxide, it is also largely used as a fine white paint. In commerce, the metal is termed *spelter*.

Zincite.—A brittle, translucent mineral, of a deep red color, sometimes inclining to yellowish, and consisting chiefly of oxide of zinc, but containing also a small quantity of oxide of manganese, to which its color is supposed to be due; also called *red zinc ore* and *red oxide of zinc*.

Zinc Plates.—Slabs of rolled zinc, placed in various positions in the interior of a steam boiler, to prevent corrosion, etc.

Zinc White.—A white powder obtained by the sublimation of *red oxide*; this is pulverized, mixed with coal, and heated in brick retorts, through which blasts of air are passed.

Zodiac.—An imaginary belt in the heavens, 16° or 18° broad, in the middle of which is the *ecliptic*, or sun's path. It comprises the twelve constellations which once constituted, and from which are named, the twelve signs of the zodiac.

Zone.—One of the five great divisions of the earth, with respect to latitude and temperature. They are the *torrid zone*, extending from tropic to tropic 46° 58', or 23° 28', on each side of the equator; two *temperate* or *variable zones*, situated between the tropics and polar circles; and two *frigid zones*, situated between the polar circles and the poles.

2. In mathematics, the portion of the surface of a sphere included between two parallel planes.

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